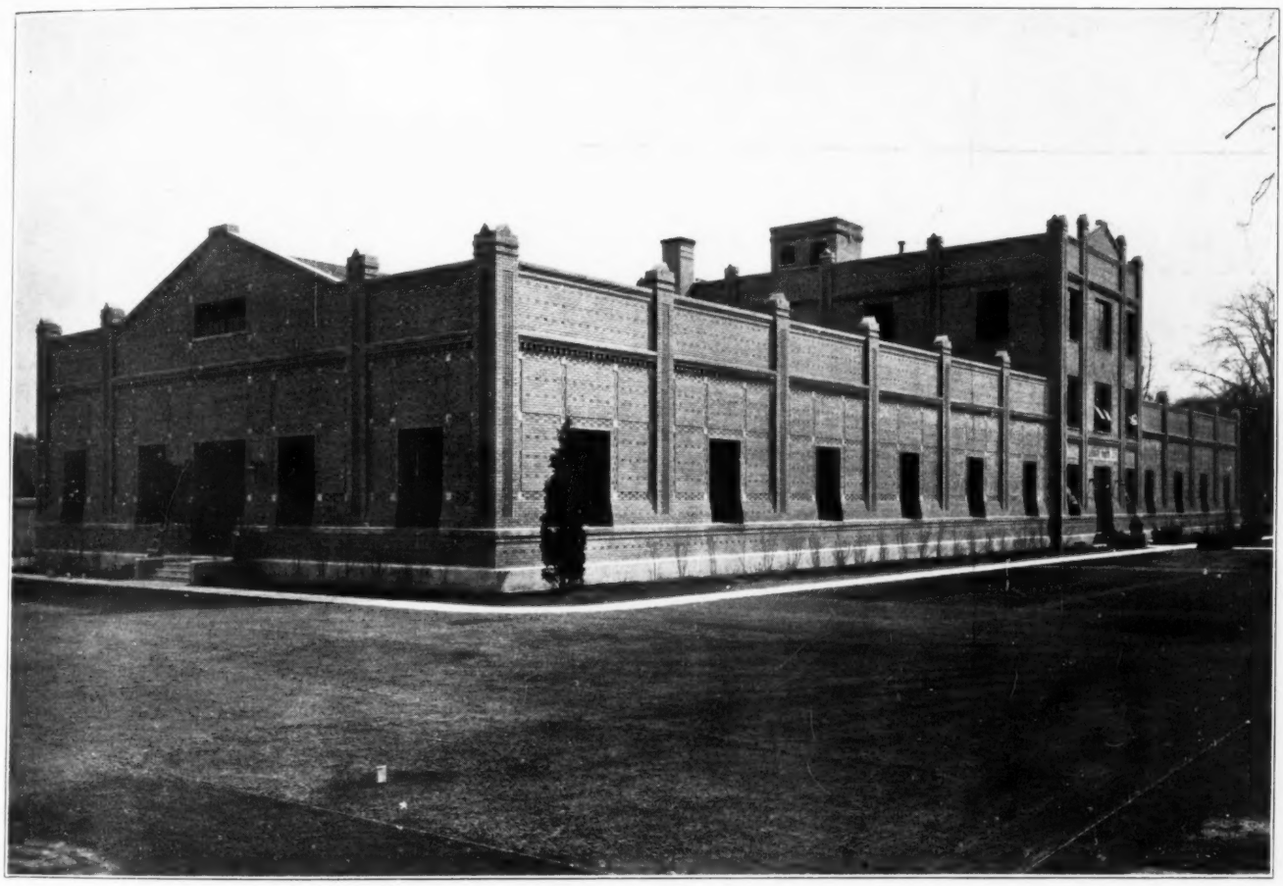
WATER-WORKS AND SEWERAGE

October, 1933 — Editor — Vol. LXXX. No. 10



The Recently Completed Filtration Plant and Pumping Station of the Lehigh Water Co., Easton, Pa.

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Portland Cement Pipe Coatings
Ammonia in Water Treatment
The New Filtration Plant of Easton, Pa.
An Economical Sewage Treatment Plant
Some Aspects of the Chemical Precipitation of Sewage
Report of Meeting of New England Water Works Association

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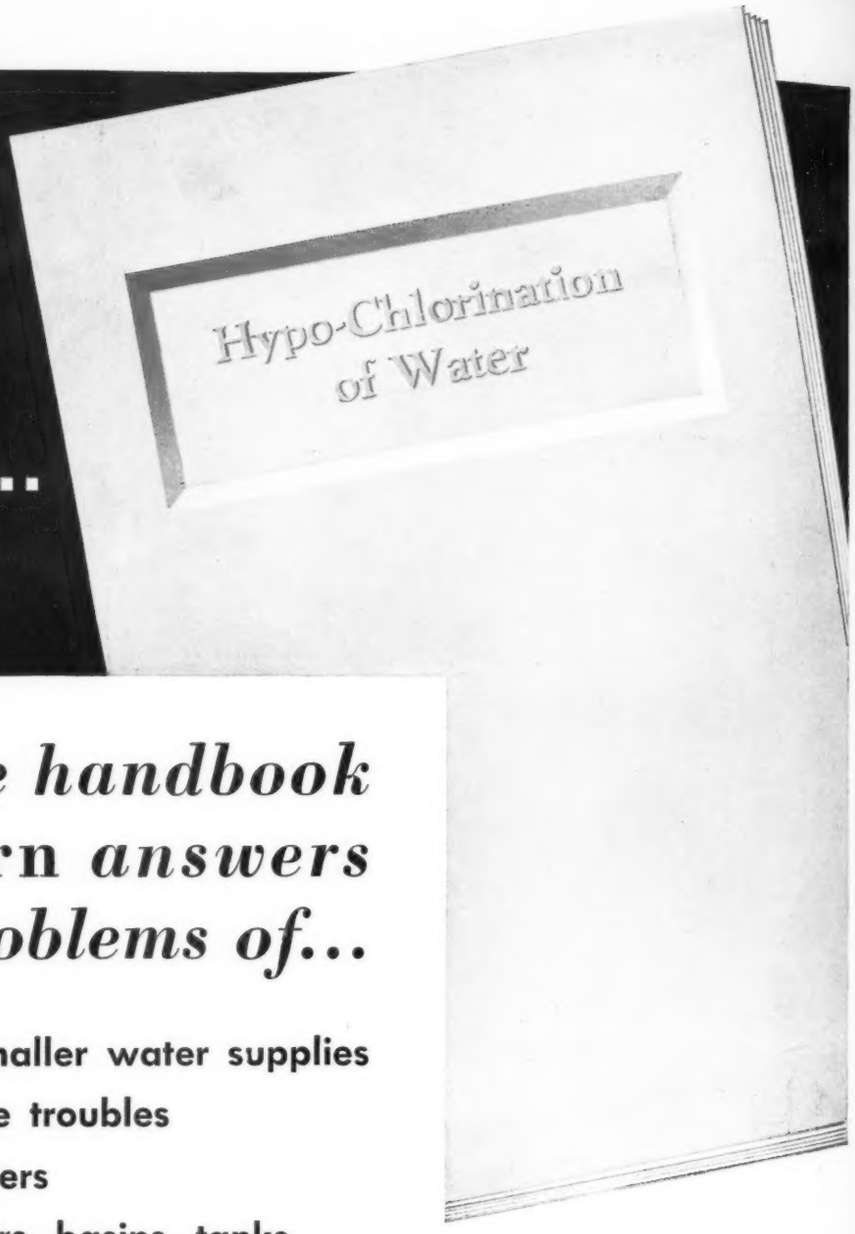

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WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

John F. Laboon, Consulting Engineer, Pittsburgh, Pa., will describe the several interesting, novel and practical features incorporated in the design of two new sewage treatment plants under construction at Lancaster, Pa.

C. K. Mathews, Burns & McDonnell Engrs., Kansas City, Mo., will tell of unique "three purpose" arrangements, and reasons therefor, which were incorporated in revamping a small water treatment plant.

J. S. Dunwoody, Superintendent of Water Department, Erie, Pa., tells of the methods followed at Erie in "Handling of Storage Yard Supplies and Equipment" in an article illustrated by specimen record forms and photographs.

Wm. B. Duffy, Supt. of Water Works, North Andover, Mass., will describe methods of making valve and hydrant inspections and system of record keeping at North Andover.

Eugene T. Cranch, Manager, New Rochelle (N. Y.) Water Company, will describe a scheme developed to prevent tampering with stop-cocks on house services which have been cut off for failure to pay water bills.

Walter A. Sperry, Superintendent of Sewage Treatment Works, Aurora, Ill., will describe a study of flow through characteristics of sewage settling tanks and means evolved to create higher efficiencies including the installation of effective devices.

Chas. H. Capen, Jr., Senior Asst. Engr., North Jersey Water Supply Commission, will discuss algae and taste control and relate some of the practical aspects of the ammonia-chlorine treatment of water as observed from first hand operating experiences.

H. H. Hendon, Sanitary Engineer of Jefferson County, Birmingham, Ala., will describe the Shades Valley project in which 3.5 miles of 42-inch special cast iron pipe with lightweight bells was employed.

H. G. Turner and G. S. Scott will report further on the use of anthracite coal as a filter material, with particular attention having been given the practical aspects—washing rates and length of filter runs.

Frank C. Roe, Engineer of the Carborundum Company, Niagara Falls, N. Y., will describe the most satisfactory methods employed in cleaning and servicing air diffuser plates and tubes at sewage treatment plants.

D. F. Irvin, Engineer, Oliver United Filters, Inc., will report on a recent survey revealing the actual costs of sewage sludge drying and disposal—the most complete report of its kind yet available.

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Published monthly by the GILLETTE PUBLISHING CO., Daily News Building, Chicago, Ill.

Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Published monthly at 400 W. Madison Street, Chicago, Ill. Per copy 25c. Subscription rates $2.00 per year. Canadian and Foreign, $3.00 per year. Copyright, 1933, by Gillette Publishing Company, Publishers of: Water Works and Sewerage, Roads and Streets, Oil and Soap, The Art of Mosaics and Terrazzo, Road and Street Catalog and Data Book, Water Works Catalog and Data Book.

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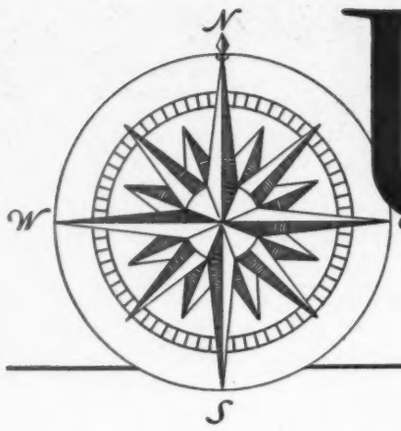
Chicago Office, Daily News Building. Cleveland Office, 2100 Keith Building. New York Office, 420 Lexington Avenue. San Francisco Office, 155 Montgomery Street.

Addresses will be changed as frequently as desired, upon notification; not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Water Works and Sewerage*, in order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.



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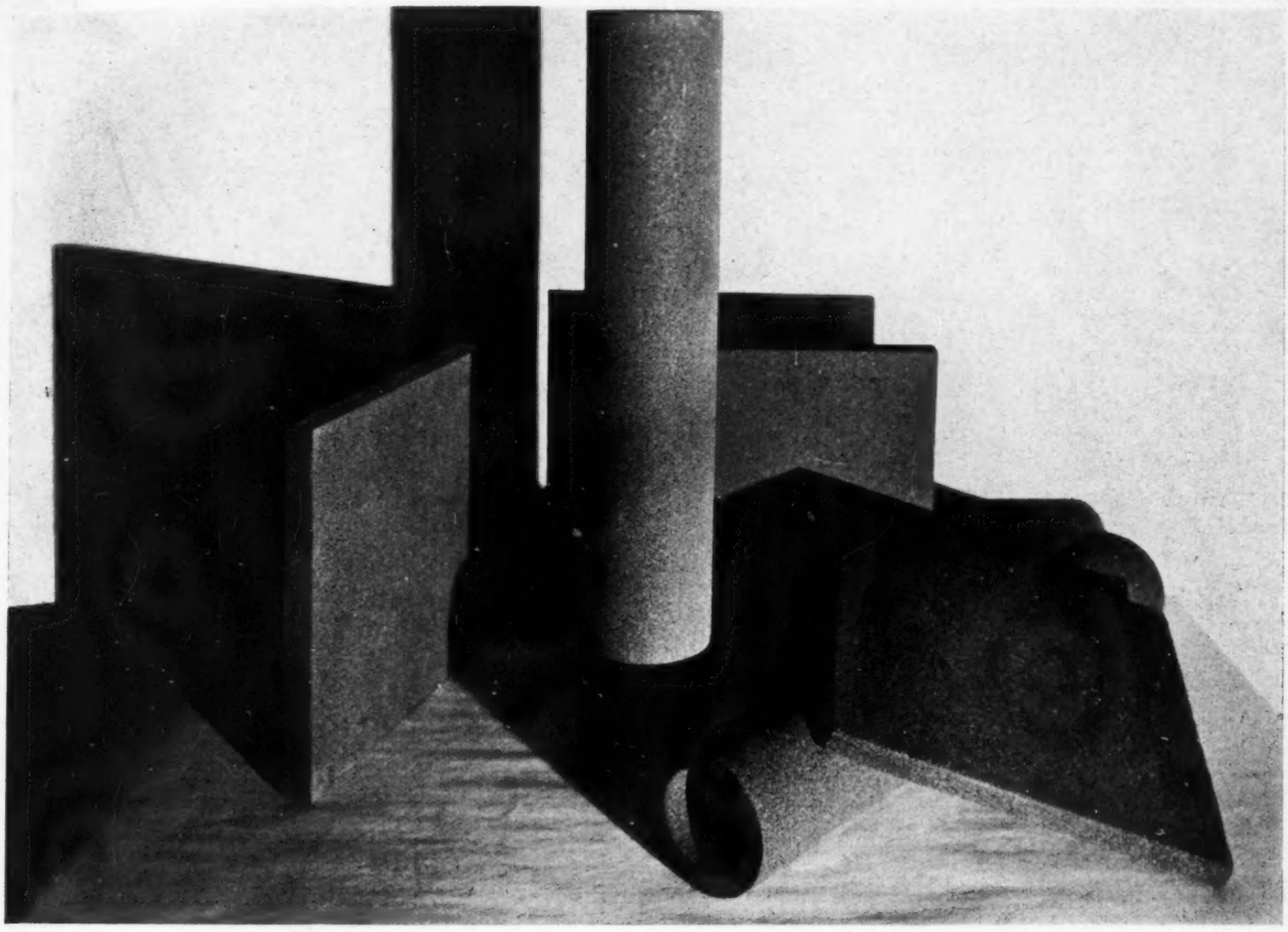

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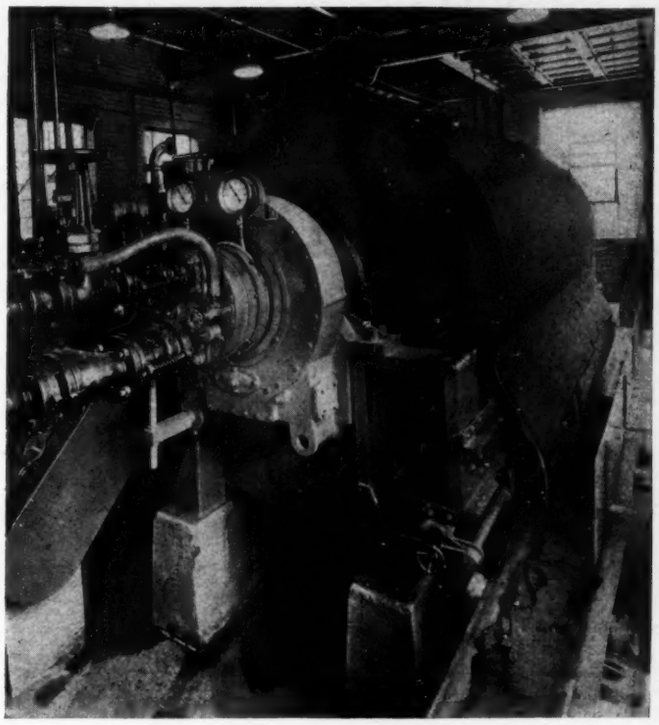

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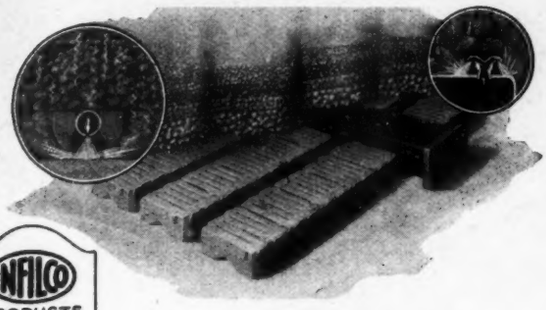

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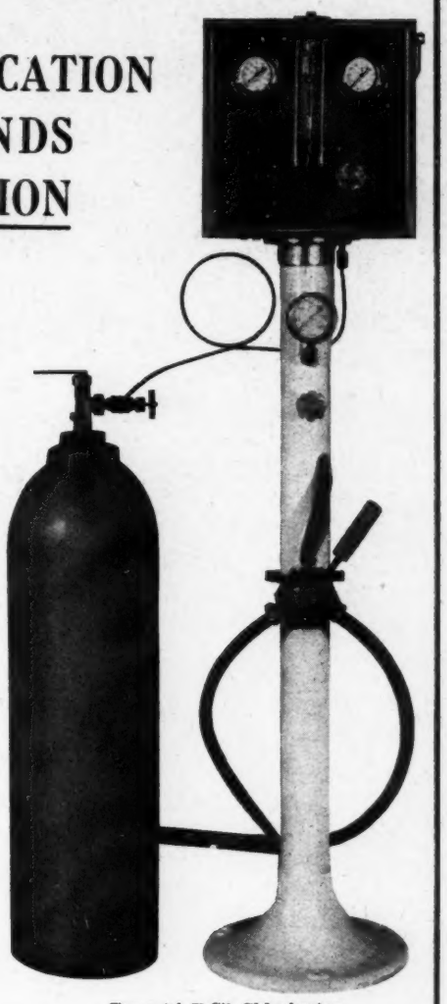

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WATER WORKS AND SEWERAGE
Oct. 1933
VOL. 80 NO. 10
A GILLETTE PUBLICATION

THE NEW FILTRATION PLANT OF EASTON, PA.

By R. W. HAYWOOD, JR.

Superintendent of Filtration, Lehigh Water Co., Easton, Pa.

THE new filtration plant of the Lehigh Water Company at Easton, Pa., is situated on the Delaware River about two miles north of the city. This plant was put into operation early in the spring of 1933 and supplies water, not only to Easton proper, but to several smaller adjacent townships. It was constructed to replace an old pumping station that had been in service for nearly half a century.

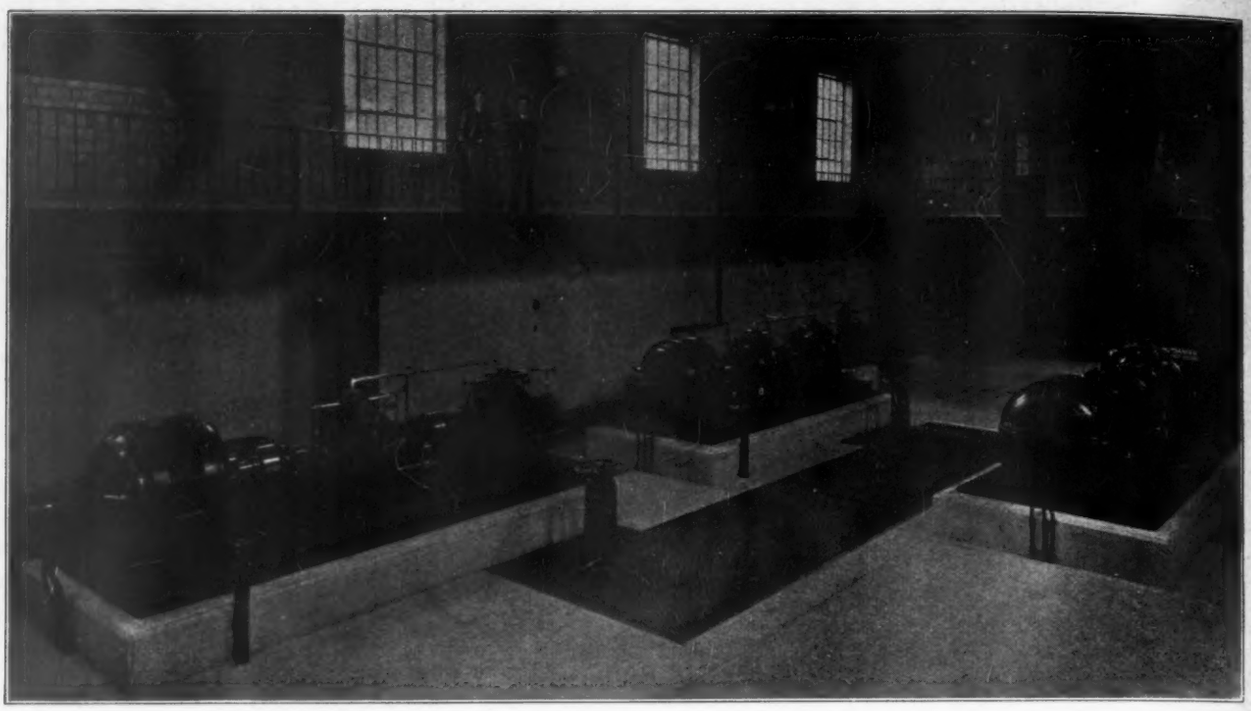
The North Delaware drive station is made up of three major units, the low service pumping station, filter plant, and high service pumping station, the first unit being housed in a separate brick building several hundred feet north of the main building which contains the last two. All pumping and treatment of the water takes place in these two buildings together with the necessary outside basins, the finished water being delivered to reservoirs for subsequent distribution.

The plant as designed and constructed consists of two four million gallon units, both raw and finished water pumps being rated at this amount for twenty-four hours against their respective heads and each of the two coagulation basins and mixing channels are designed for operation at a 4 m.g.d. rate each. There are eight rapid sand filters, each rated at 1 m.g.d., and two additional outside basins placed on either side of the coagulation basins. A unique feature of the plant is the north basin which provides storage for spent wash water, the south basin serving as a primary sedimentation basin from which the water flows to either or both mixing channels. Since there is a public bathing beach directly below the plant, it is not desirable to discharge waste water into the river while there are bathers present. This makes the waste water storage basin of especial value during the swimming season as a means of restricting the flow of waste water to periods during which it may be discharged safely. This waste water may also be mixed with the incoming raw water if desired and passed through the plant again.

Perhaps tracing the path of the water from the river until the time it leaves the plant as a finished product, will give a clearer and more accurate picture of the plant and some of the unusual features about it.

As has been indicated, the Delaware River is the source of supply. It carries no noticeable load of industrial wastes above our intake and therefore the problems of purification are almost entirely created by natural causes. There is a gravity flow into twin suction

The Recently Completed Filtration Plant and Pumping Station of the Lehigh Water Co., Easton, Pa.



High Service Pumping Station Equipped With 4 Cameron Pumps and 4 Simplex Valves

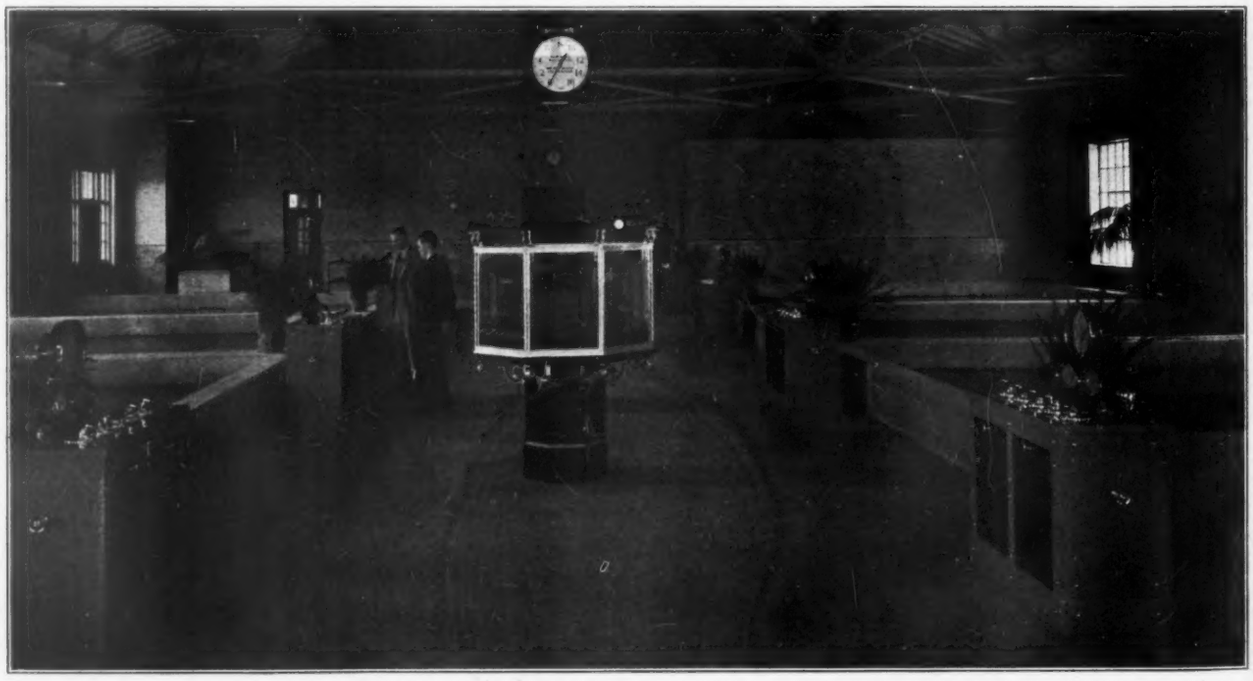
wells of the low service pumping station, either or both of which may be used as desired, the water first passing through coarse, bar screens with three inch openings and thereafter through finer wire screens of three-quarter inch mesh before being picked up by the pumps.

Raw Water Pumping Station and Prechlorination

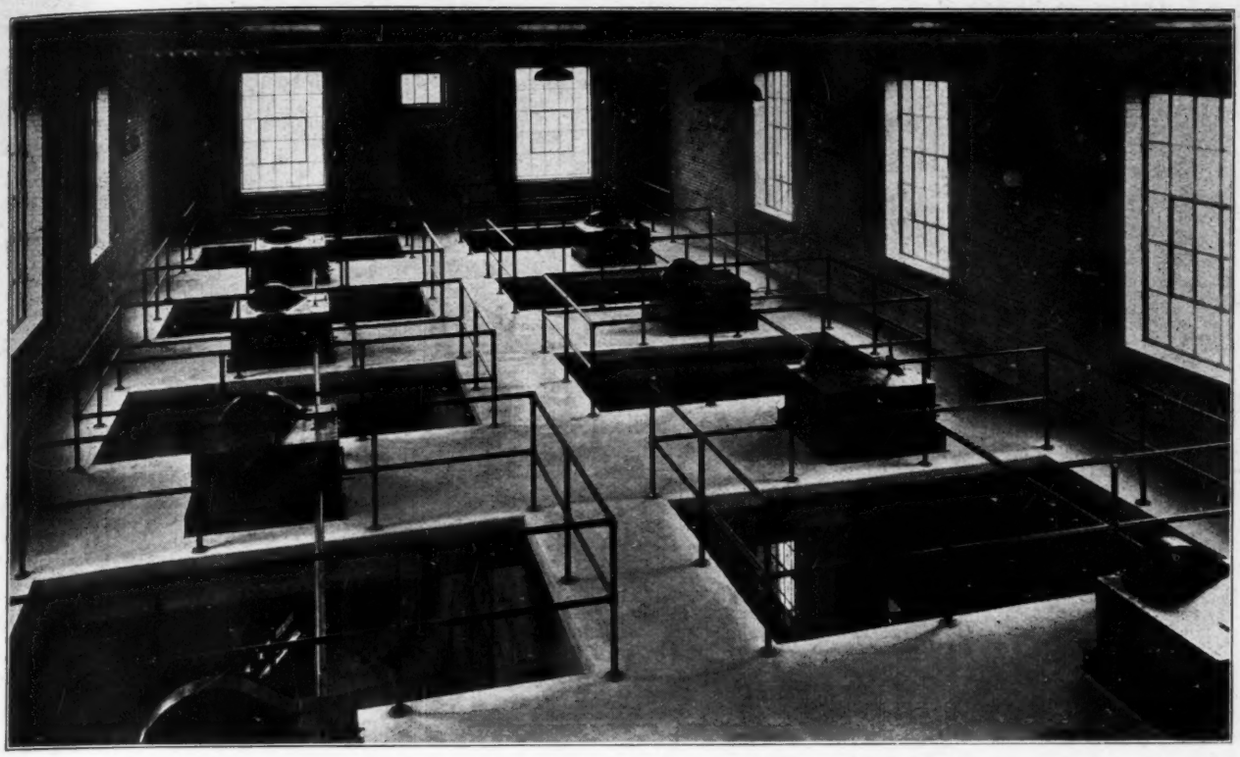
There are three Cameron No. 10 NFV centrifugal pumps, each rated at four million gallons per day against a 50 ft. head and driven by a 50-h.p. General Electric motor. These pumps force the water to the main plant through a 30-inch main which delivers either to the primary sedimentation basin or directly to the mixing channels. A primary chlorine dosage is applied by Wallace & Tierman Type MSVM chlorinators to the raw water just before it enters the primary sedimentation basin. This basin has an effective capacity of 333,000 gallons with the water at its normal depth of 15 ft., and has a theoretical retention of two hours at a 4 m.g.d. rate or one hour at 8 m.g.d. It is divided into two equal sections by a lateral stilling baffle, an arrangement common to all the outside basins, and has been in use since the plant was put into operation. From this basin the water flows to either or both of the mixing channels.

Mixing and Coagulating

Just prior to entering the mixing channels chemicals are applied. These are filter alum, hydrated lime, and



Filter Operating Floor, Easton FilterPlant. Wash Water Gauge in Center



Hardinge Mechanical Mixers; One on Right in Service

activated carbon, all being fed by Wallace & Tiernan Type O dry feed machines. The chemicals are stored on the third floor directly above the dry feed machines and are fed to the machines through loading hoppers that extend from this floor to the machines on the floor below.

Each of the two mixing channels have an effective capacity of 122,000 gallons at the normal depth of 15 ft. and a retention period of 43 minutes at a 4 m.g.d. rate. Each mixing channel is equipped with four mechanical mixers made by the Hardinge Company, Inc., of York, Pa. Each mixer consists of a vertical shaft that extends to the bottom of the channel on which are bolted two 10 ft. horizontal cross arms at right angles to each other and about four feet apart. From these cross arms rectangular iron plates are suspended, each arm support two on each side of the center shaft, making a total of eight plates, or "paddles," for each unit. The vertical shaft is supported by bearings at the top, the bottom being held in position by a lignum vitae guide that supports none of the weight.

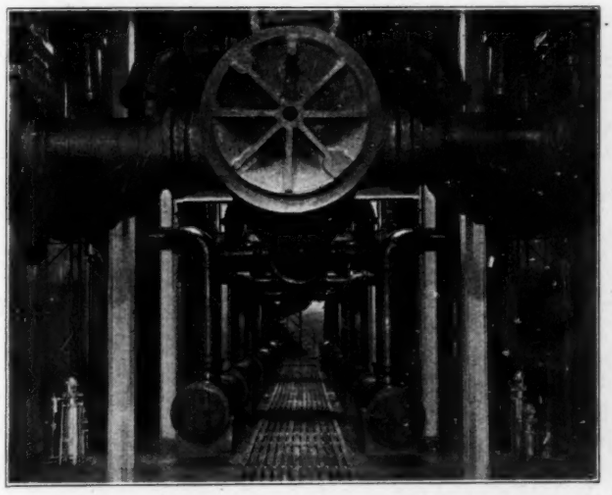
The four mixers are driven by one power unit, a General Electric 5-h.p. motor, that supplies power to the main driving shaft through a Reeves vari-speed pulley and a D. O. James worm gear speed reducer. Flexibility is obtained through the Reeves pulley, the mixing paddles being rotated at a minimum speed of 1 to a maximum of 3 revolutions per minute. Additional flexibility is available because of the fact that each unit has its own clutch, allowing the use of any combination of mixers. The number of steel paddles on each unit can also be changed and the rate of mixing increased or decreased thereby.

Coagulation Basins

An arched opening allows the water to flow from the mixing channels into the coagulation basins, there being a baffle extending entirely across each basin from the bottom to about four feet from the surface and four feet from the end wall to aid in preventing short circuiting. Each coagulation basin has an effective capacity of 500,000 gallons at the normal depth of 15 ft. and a retention period of three hours at 4 m.g.d. A lateral stilling baffle divides each basin into two equal sections. The effluent is taken off through a 30 in. pipe located in the center of an open channel reaching completely across the lower end of the basin about 6 ft. from the bottom, this channel being 4 ft. wide and 5 ft. deep and extending to within 4 ft. of the surface.

The Filters

The filters, arranged in two groups of four each, were installed by the Norwood Engineering Company, of Florence, Mass. They are equipped with Simplex rate of flow controllers and rate of flow and loss of head indicating and recording gauges, the latter being mounted



Pipe Gallery. The Large, 30-in. Pipe Brings the Water from the Coagulation Basin to the Filters. Below Can Be Seen the Two 20-in. Collecting Mains Carrying Filter Effluent. Simplex Rate Control Equipment Appears in the Lower Corners

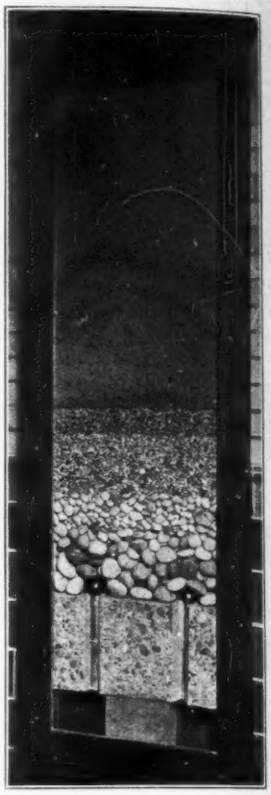
Two of the Five W and T Type O Dry Feed Machines. The Loading Hoppers May Be Seen Above the Machines

on the individual control tables. Water enters each unit through a 16 in. pipe at one end. It leaves the filter through 840 ¾ in. brass nipples which are equipped with umbrella type strainer head, the nipples being cast in the concrete filter bottom. The false bottoms are about two feet deep and extend under the entire unit. The filter effluent leaves the false bottom by way of a 10 in. pipe into a collecting header in the pipe gallery. There are two such headers, one for each set of filters which are cross connected by a lateral through which the filtered water flows into one end of the clear well. At this point the secondary lime and ammonia are applied and at the opposite end of this half of the clear well there is an illuminated white tiled sight well, which enables the operator to observe the visual quality of the filtered water. An exceptionally fine grade of hand picked gravel was used in the filters. The coarse gravel came from Reiglsville, Pa., while the finer gravel and filter sand came from Cape May, N. J. Each filter has an area of 360 sq. ft. and is made up of 45 tons of sand and 27 tons of gravel. Both the influent and effluent filter lines are quipped with lever regulators supplied by the Simplex Valve & Meter Co. The one on the influent maintains the water on the filters at a constant level while the one on the effluent prevents the clear well from overflowing.

Wash Water Facilities

The room next to the chemical storage room on the third floor contains the 50,000 gallon wash water tank which holds the water used to wash the filter. In the line connecting the tank with the distributing header is another Simplex rate of flow controller connected with which is a large, clock-like, double-faced indicating meter which is suspended above the filter operating floor and indicates the rate of wash water flow in millions of gallons per day. The pump which lifts the water to the wash water tank is a Cameron No. 10, NFV centrifugal pump, rated at 1,000 gallons per minute against a 62 ft. head, and is driven by a General Electric 20-h.p. direct connected motor.

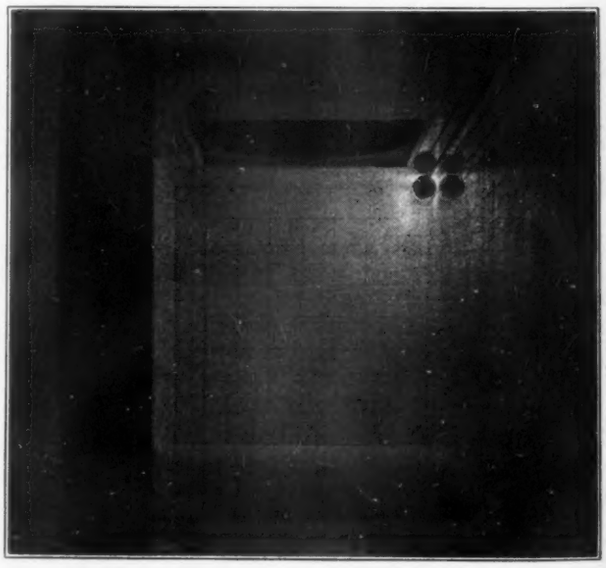
Outside the filter room at the end of the building there is an underground sump, or storage basin, into which the spent wash water flows as it leaves the filters. A Cameron No. 6, NFV centrifugal pump, rated at 1,000 gallons per minute against a 30-ft. head, lifts this water into the larger open storage basin next to the coagulation basin from which it can be discharged gradually to the river or returned to the raw water inlet.



Cross Section of Filter. In Lower Portion May Be Seen Strainer Heads and Nipples Through Which the Water Enters the False Bottom

The Clear Well

The clear well is divided into two portions, connected by a 30-inch lateral, each located directly below one of the two groups of filters. All filtered water is carried to one end of the first section by the collecting mains, mentioned above, through the 24-inch lateral which ends in a "T" with one end blanked off. In the open end is placed a 24-inch riser which is surrounded by a 30-inch pipe of equal length, in the bottom of which has been cut several six inch holes spaced at equal intervals. This arrangement provides a fixed head against which the filters operate at all times and increases their efficiency materially. The arched openings admit the water from the last section of the clear well into the high service pump sump located directly below the chlorine



Filtered Water Observation Well, Looking Down Into the Well Through 9 ft. of Water. The Circular Opening Is the Bell of the 30-in. Lateral Connecting the Two Portions of the Clear Well

room, from which it is drawn through two 30-inch suction lines by the high service pumps. Secondary chlorine is applied in this sump just before the water is picked up by the pumps.

High Service Pumping Station

The high service pumping station contains the pumps, main electrical switchboard, and four Simplex meters. There are three Cameron No. 10, SHV centrifugal pumps, each consisting of two single stage, double suction pumps close coupled in series and rated at 4,000,000 gallons per day against a 300 ft. head. These pumps are driven from one end by General Electric, 300-h.p., synchronous motors and discharge the water through one of the two 24-inch effluent lines which unite outside the building to form the high service pumping main. Two of the Simplex meters measure the water flowing through these lines while one of the remaining meters measures the water entering the plant through the main from the low service station and the other measures the quantity of water pumped to the wash-water tank.

Plant Personnel

The personnel of the plant consists of a superintendent of filtration, an assistant superintendent, three filter operators, and three operator's assistants. The plant is operated on three, eight hour shifts, one operator and assistant being used on each. A completely equipped laboratory affords means for a constant check-up on all phases of plant operation and for making chemical, bacteriological, and microscopical analyses.

The plant was designed by J. W. Ledoux of Philadelphia, Pa., and constructed under his direction until his death. At that time his associate, G. L. Bean, took over the work and it was completed under his supervision. The Turner Construction Company of New York and Philadelphia were the holders of the general contract and Edgar A. Wightman of Philadelphia was the architect. All pumps were furnished by Ingersoll-Rand Company, Phillipsburg, N. J., and cast iron pipe by the Warren Foundry & Pipe Co., of Phillipsburg, N. J.

The Influence of Dissolved Oxygen on Corrosion Losses

The slow but certain tuberculation and eating away of water pipes by some waters is adding an enormous amount to the cost of modern civilization. Engineers and chemists are constantly studying the theories and mechanics of corrosion because it is only through better understanding of fundamentals that they will be able to diminish losses due to corrosion.

Thirty years ago, R. W. Whitney, now vice-president of the General Electric Company, announced that the corrosion of metals was an electrochemical process and this view is now generally accepted. When a metal is in contact with even slightly acidic solutions, corrosion takes place by the chemical process of the metal replacing the hydrogen in the acid. The acid dissolves the metal and thereby hydrogen is released.

Released hydrogen coats the metal surface with an electrically charged layer that prevents the chemical reaction from continuing at the initial rate. If the hydrogen layer is built up to a sufficient thickness the reaction is practically stopped. However, under natural conditions, the hydrogen combines with the oxygen of the air or that dissolved in the water to form more water and solution of the metal goes on. The amount of oxygen available to remove the protective hydrogen blanket determines the extent of corrosion.

Impure metals are corroded more quickly as a rule than pure metals. Electrochemists believe that this is due to the impurities taking up the oxygen. Contrary to the popular belief, however, pure metals are subject to corrosion under the action of certain acid solutions. Prof. O. P. Watts of the University of Wisconsin has recently shown that if oxygen is absolutely excluded copper will not corrode in a solution of sulfuric acid, a reaction that is very rapid in the open.

The importance of the dissolved oxygen content of the atmosphere, of corrosive water and other liquids, is thereby once more emphasized. When this element is present in high concentration a higher pH value must be maintained to prevent corrosion of mains than otherwise and particularly of household services or piping subjected to increased temperatures which create accelerated attack.

This suggests that there may be some doubt as to the merits of aeration of certain waters which are normally aggressive, unless the pH value is raised sufficiently by alkali addition to reduce the hydrogen ion concentration considerably below that of pH 7 which is commonly considered to represent a neutral water. It has in fact been demonstrated that ofttimes waters high in oxygen content and low in hardness must be raised to pH value 9.5 in order to check even the cold water corrosion of mains.

Registration of Plant Operation Required in West Virginia

Chapter IV, Art. 1, Regulation 3, as amended by the Public Health Council of the State of West Virginia in regular session July 13, 1933, contains the following requirements:

Those persons employed as municipal or privately owned filter and chlorination plant operators, chemists, bacteriologists and superintendents of filtration who are in actual charge of operation and who are held responsible for the quality of the finished water, must be registered by the State Department of Health after July 13, 1933. Persons employed before passage of this regulation shall qualify with the State Health Department before January 1, 1934.

Written and oral examinations will be held in the office of the State Department of Health or any of the full-time county health units upon request of an applicant for a position. A grade of 70 or above shall be considered passing.

The following certificates of registration shall be issued:

Operator 1st Class: To superintendents of filtration, chief chemist or chief operators of plants where filtration or softening are accomplished and bacteriological and chemical control used.

Operator 2nd Class: To chemists or operators of filtration plants where the control is by chemical tests only.

Operator 3rd Class: To operators of plants where chlorination is the only treatment.

Any failure of an operator to comply with the requirements of the State Department of Health *or to operate the treatment plant in a diligent manner* shall constitute a violation of this regulation with the revocation of certificate of registration.

Ohio Conferences to Be Held October 17-20 in Findlay.—The Ohio Conference on Water Purification will be held on October 17th and 18th and the Ohio Conference on Sewage Treatment on October 19th and 20th—both meetings to be held in Findlay, O., at the Elks Club Auditorium. Headquarters hotel is the Phoenix. Clarence Hoover of Columbus will address the conference on "Sewage Treatment in Germany."

WILL THE PUBLIC WORKS PROGRAM SERVE ITS PURPOSE?

By HAROLD L. ICKES

Secretary of the Interior and
Administrator of Public Works

IT is now largely in the hands of the mayors of our cities to determine whether the Public Works Program will fully serve its purpose in aiding in the economic recovery of the country. Our national treasury is waiting to be drawn upon for hundreds of millions of dollars for useful public works. The Administration in Washington can approve your projects and advance funds necessary to complete them. We have moved and are moving expeditiously, if circumspectly, but there is a point beyond which we cannot go. We can give you money; we can help you to decide what project to undertake; we can assist you with your plans and your specifications and the letting of your contracts; we can aid you in supervising your work; we can meet the charges of the contractors when they fall due; we can even encourage you to speed up your projects. But we cannot do more than this. We cannot decide for you whether you want public works. We cannot make you borrow money from us on favorable terms. We cannot force you to move any faster than you are willing to move.

The Public Works Program, contemplating as it does the expenditure of funds in excess of $1,750,000,000 for state and municipal projects, offers the greatest opportunity for municipal improvements in the history of any country. We are willing to advance you as an outright gift 30 per cent of your outlay for labor and material on an approved plan. We ask you to pay for the balance of the project. But we are willing to help you to finance your share. We will advance you the remaining 70 per cent upon approved security and by approved security I don't mean that we will be as finicky about the security that you may offer as would be the investment bankers with whom you are accustomed to deal. We will lend you this 70 per cent at a 4 per cent interest and permit you to amortize it over a period not to exceed 30 years.

Here is an opportunity to build necessary and desirable public works on more favorable terms than you have ever had before or than you may ever have again. Do you need new water works, or an extension of your present plant? Do you want a new or improved sewerage system? These things and others you may have on unbelievably generous terms.

Naturally, the purpose of the Public Works Program is not merely to do work for the sake of doing the work. We want to increase buying power because it is realized that without increasing buying power our recovery program will fail. In this the municipalities are as much interested as the Federal government.

If at the same time that we increase buying power we build useful and socially-desirable public works, we are accomplishing two fine results by the same effort. I need not point out to you that for every hundred thousand men at work on public works projects there are at least an equal number at work back of the lines producing materials.

Complaints have come to the Public Works Administration from several quarters that the minimum wages stipulated to be paid on public works projects are too high. Those who voice this criticism, as I see it, do not have a proper view of the situation. Our avowed object is to increase buying power. We cannot increase buying power effectively or to any considerable extent if we do not pay enough wages so that people will have more than a mere subsistence income.

Status of Municipalities

It may be urged in some quarters that the municipalities in many instances have reached the limits of their bonding powers. There are tax strikes on here and there throughout the land. Real estate values have gone off so sharply that the tax yield from the necessarily lower assessed valuations is not sufficient to meet current expenses, let alone interest even at 4 per cent on a new municipal obligation.

I am familiar with this situation because, for many years, I have been particularly interested in municipal government. But I know that there is another side to this picture. I know that people would be more willing to pay their taxes if they were assured of equitable assessments.

The very plight of some of our cities offers a rare opportunity for forthright leadership. I predict that our of this present period of strain and stress a new concept of the duty of the average citizen to his city, a new sense of responsibility on the part of our elected officials, will be born.

The sum of approximately $1,600,000,000 has already been allocated by the Public Works Administration. Latterly, we have been devoting the major part of our attention to municipal projects. We want to get these under way without loss of time. We want them to be as widespread as possible and to provide the maximum of employment.

We are not being technical. We do not even ask that any municipal project be brought to us in perfect engineering, legal and financial form before approving it. We have adopted a system of tentative allocations of funds. On my motion, the Special Board for Public Works, about a month ago, adopted a resolution as follows:

"Resolved, That upon a proper prima facie showing that a proposed state or municipal public works project is socially desirable, is satisfactory from an engineering point of view, and can be financed under the law, the Public Works Administration may make an allocation of the money required for such project on the condition that not later than thirty days after such allocation, the financial and engineering features of said project be worked out and a final contract, satisfactory to the Administrator of Public Works, be executed, failing which the tentative allocation shall be without effect."

Here is concrete evidence of our willingness to proceed without loss of time and with a minimum of technicality. Come to us with a prima facie case and we will set aside the money for you. Then you can proceed without delay to supply us with the necessary explicit engineering, legal and financial details. Bring us your projects supported by the facts that are undoubtedly within your knowledge and *you will get prompt action!*

Note: The above paper is composed of excerpts from an address delivered by Secretary Ickes before the Mayor's Conference at Chicago, Sept. 23, 1933.—Ed.

THE NEW ENGLAND WATER WORKS ASSOCIATION HOLDS 52ND ANNUAL CONVENTION

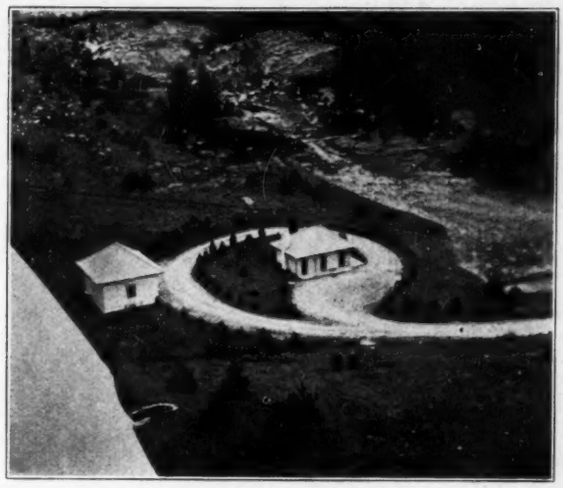
THE 52nd Annual Convention of the New England Water Works Association was held in Bridgeport, Connecticut, on September 19th-22nd inclusive. The attendance approximated 425.

Reports on Public Works Administration Activities Featured

Following a report by President-Elect E. Sherman Chase covering activities of the Association's Committee on National Recovery, the meeting was addressed by L. A. Hoffman, State Engineer in Charge of P.W.A. activities in Rhode Island and Connecticut.

Mr. Hoffman analyzed the procedure through which municipalities must go in securing loans from the N.R.A. for Public Works construction, defined requirements to be met and discussed other considerations. He stressed the fact that in making application for a loan, or the grant, nothing more than a general layout plan with sufficient data or details essential to making cost estimates need be submitted for action; that the time required should be not more than 10 days for approval by State authorities and submission of the application to the Washington authorities for final action. Only after that should more complete plans, specifications, etc., be drawn. He said that an important element to be considered was the matter of securing loan and grant as against that of procuring the grant alone. Cities which could arrange to borrow outside of the N.R.A. were favored by the Administration and could be given the Federal grant promptly. In doing so it was evident that the funds of the N.R.A. would be available to assist a greater number of cities and thus serve in getting a larger number of projects under way. For this reason preference would be given applicants for the 30 per cent grant provided the other 70 per cent had been assured through regular financing procedures.

In making preparation for a million dollar project grant it was estimated that engineering would cost 5% ($50,000); securing rights of way and land, another $50,000; interest during construction about $25,000. The total amounting to about 12.5 per cent ($125,000) was deductible from the total cost of the project in calculating the grant which would be allowed—in this case the grant would be $250,000 and represents 25 per cent on the entire cost. In the matter of large equipment purchased, the proportionate life of that equipment could be figured in as equipment cost on the particular project—a recent ruling.



Ammoniation and Chlorination Station, Bridgeport Hydraulic Co., Looking Down from the Dam.

Mr. Hoffman explained the two optional plans of financing—the first requiring no outlay of money for the first few years, the grant being used to cover interest and amortization during that period. The second scheme involved payments of interest and amortization beginning the first year. He stressed the value of being prepared in advance when making loan applications—citing the case of Norwalk, Conn., which was passed on very quickly because everything was ready. Work should be under way very shortly on this project.

Replying to questions, he said that local review of applications by the State Engineer's office should require between one and three weeks, depending upon circumstances surrounding the case, and that a week additional would be required to get final approval from Washington. After approval the grant money would be paid monthly, using as a basis the analysis of costs. Engineering costs were not allowed under the heading of labor costs except where it represented actual field work during construction. Preliminary surveys and preparation of plans were a part of the first costs referred to and are deductible before computing the grant. Private water companies could not procure Federal grants but were eligible to receive N.R.A. loans.

W. J. Scott said there had been some complaint of "red tape" in getting loans, but in Connecticut the quickness with which loans had been approved indicated what could be accomplished with applications that were in good shape.

Gerald P. Knight in commenting on the need for stimulating the promotion of public works projects struck a key-note when he said that perhaps the greatest obstacle to be dealt with was the timidity of municipal authorities at this time when expenditures are so unpopular with taxpayers. He considered that it was up to consulting engineers and water works officials to take the lead in stimulating interest and in promoting projects—to give argument and courage to those authorities inclined to be timid.

Richard H. Ellis, Retiring President of the Association.

E. Sherman Chase, President of the Association.

Mr. Hoffman said, that the only answer to the question raised by city authorities and taxpayers—"Why go into public works projects at an increase in rates?"—was that it was a patriotic duty of the city—not losing sight, however, of the fact that here was an opportunity to gain in the long run.

Award of Honors

The Dexter Brackett Memorial Medal was presented to Charles W. Mowry, Manager of the Department of

Chas. W. Mowry, Dexter Brackett, Medalist, 1933.

Roger W. Esty, Vice-President.

Inspection, Factory Mutual Fire Insurance Companies Associated, for his outstanding paper on "Water Consumption During Fires." This award was made at the annual banquet as was the conferring of Honorary Memberships on W. W. Brush, of New York City; W. F. Sullivan of Nashua, N. H., and Robert Spurr Weston of Boston, Mass.

Inspection of the Bridgeport Hydraulic Company's Sources of Supply

The afternoon of the 20th was devoted to an inspection of the three main reservoirs of the Bridgeport Hydraulic Company and ammoniation and chlorination stations. On the water-shed areas owned by the company are extensive fruit orchards and a modern fruit packing and cold storage plant operated by the company at a profit as are also the nurseries in which shrubs and evergreens are grown for reforestation work and marketing. The visitors were impressed with the dams, the reforestation work and the very excellent condition and appearance of the properties of the water company as a whole. To have inspected the reservoir areas and have met the officials of the Bridgeport Hydraulic Company is to understand why the Mayor of Bridgeport and the President of the Chamber of Commerce, in their addresses before the Association, paid high compliment to the Bridgeport Hydraulic Co. and its management.

Social Activities

The annual banquet was particularly enjoyable because of the fact that it might be termed a "speechless dinner." The dancing which followed got under way at a comparatively early hour.

The Smoker and variety entertainment was of first water caliber. Burt Hodgman, in addition to having arranged this high class entertainment, served with Arthur Clarke as one of the "victims" on which a very clever magician pulled some fast ones.

Business Meeting and Election of Officers

ALBERT L. SAWYER,* Treasurer, reported a balance of funds in bank of $1,955.00 and an accumulated reserve fund of $17,000.

GORDON M. FAIR, Editor, reported no less of advertising in the Journal during 1933. The production of the Journal had cost $4,712 which spread over the 800 members represented an annual gross cost of $5.85 per member. Deducting advertising income the net cost had been $1.46 per member.

Officers elected for the year 1933-1934 are:

President—E. Sherman Chase, Consulting Engineer, Boston, Mass.

Vice-President—Roger W. Esty, Supt. Water Works, Danvers, Mass.

Secretary—Frank J. Gifford, Community Water Service, Dedham, Mass.

Treasurer—Albert L. Sawyer,* Water Registrar, Haverhill, Mass.

Director—George A. Sampson, Cons. Engr., Boston, Mass.

Manufacturers' Exhibits

There were 39 manufacturers who displayed exhibits of materials and equipment. Among the new-comers who have not before been represented were: Baldwin-Southwark Corp., of Philadelphia, manufacturers of Precision Pressure Regulators and other valves and special water works equipment, and Proportioneers, Inc., of Providence, R. I., manufacturers of chemical feed and proportioning equipment of unique design for water works and sewerage.

Bridgeport Water Supply

The Hon. E. T. Buckingham, Mayor of Bridgeport, had said in his luncheon address of welcome that the Bridgeport Hydraulic Company was, among other things,

S. P. Senior, President and Chief Engineer, Bridgeport Hydraulic Co.

D. H. Hall, Superintendent, Bridgeport Hydraulic Co., and No. 1 Golfer (Low Gross).

a highly progressive organization looking ahead into the future at all times and one of Bridgeport's greatest assets. How true the Mayor had spoken was in evidence to those who heard the following papers descriptive of the Bridgeport supply presented by officials of the water company.

"General Description of the Bridgeport Hydraulic

*Mr. Sawyer, who was 69 years old, returned to his home in Haverhill and died suddenly the day after the close of the meeting. He had served as Treasurer of the Association since 1924.—*Editor.*

Company's System"—SAMUEL P. SENIOR, President and Chief Engineer.

Mr. Senior described the system, the water-shed areas of which are owned and controlled by the water company, and referred to the valuable coöperation of the State in the matter of preventing misuse of the streams and reservoirs. Three main reservoirs, he said, stored the water which was being treated with ammonia and chlorine. The reservoirs, having different elevations, were interconnected—the flow of water out of each being regulated by pressure control valves located at various

F. C. Barrows, Chemist, Bridgeport Hydraulic Co.

Caleb M. Saville, Chief Engineer, Metropolitan Water District, Hartford, Conn.

points on the system. The present water consumption of 27 M.G.D. had been an indicator of the improved manufacturing situation because the consumption by industry had been on an increase since June.

Mr. Senior referred to the side lines of the company which operated a $30,000 nursery business, fruit orchards of many acres, and a packing and cold storage plant. Reforestation of sheds had been an important part of the company's activities for many years.

All construction work, including the dams (which he referred to as "home made" dams) was done by the company at an important saving of at least 20 per cent in cost and without possible squabbles with outside contractors. When undertaking major construction the company's force was recruited from contractor organizations to obtain skilled and experienced personnel. (The appearance of the company's structures gave evidence that Mr. Senior's plan would stand on its own.—Editor.)

"Operation of the Bridgeport Distribution System"—D. H. HALL, Superintendent, Bridgeport Hydraulic Company.

Mr. Hall said that the distribution system embraced 400 miles of cast-iron mains, the smallest pipe in the grid-iron system now being 8 inch with all secondary feeders of 12 inch diameter or larger. The company had made a definite plan 20 years ago and was rapidly completing it—a statement suggested by the Fire Underwriters report of 1931 which carried no recommendations as to further needed improvements.

The system had been strengthened by cleaning 62 miles of main. Flushing operations were frequent on dead-ends and at low points and records of such operations had been carefully kept. All gate valves were now inspected at least yearly and records kept. The systematic inspection of services had made metering less important than otherwise. The newer services and replacements had all been made with copper tubing. Based on experience with lead vs. compounds, "Leadite" and "Hydrotite" had been selected as the preferred jointing materials.

Mr. Hall was loud in his praise of the scheme of automatic pressure regulation and the operation of the Ross Co.'s pressure control valves installed at strategic points and set to maintain a continuous and uniform 24 hour service pressure of 80 lbs. per sq. in. The scheme had proven advantageous in many ways and leaks and breaks had been reduced to unimportant figures.

"Purification of the Bridgeport Supply"—FRANK C. BARROWS, Chemist, Bridgeport Hydraulic Company.

Mr. Barrows said that the Bridgeport supply had been chlorinated at the outlet of the three reservoirs for many years—chlorinated lime was used in 1911 to be displaced by chlorine gas in 1916. Automatic dry feed chlorinators had been installed in 1918 to be later (1929) supplanted with the modern solution feed vacuum type Wallace and Tiernan chlorinators. To operate the latter, pressure water was being procured from Ross Hydraulic Pumps operated on low head from the reservoirs to build up the pressure required to operate the chlorinators against the reservoir head.

The use of anhydrous ammonia ahead of the chlorine had been tried on one source of supply in 1932. The results had warranted its application at the two other reservoirs in 1933. As a result, they had found dead-end flushing could be reduced and residual chlorine had been maintained at points 4 miles from chlorinator station—in fact all over the system. The use of copper-sulphate for algae control had been reduced to 12,600 pounds per year from the previous consumption of 30,000 pounds. The chlorine dosage averaged 3.5 lbs. per million to maintain 0.2 p.p.m. residual, involving the use of 30,000 lbs. of chlorine and 5,400 lbs. of ammonia per year. Mr. Barrows, with just pride, pointed to the very high rating of Bridgeport in the matter of water

Alexander Potter, Consulting Engineer, New York City.

Chas. G. Richardson, Chief Engineer, Builders Iron Foundry, Providence, R. I.

borne disease—there being not a single death from typhoid in 1932.

"Water Shed and Forestation Work"—W. C. POLLITT, Engineer, Bridgeport Hydraulic Company.

Mr. Pollitt said that the reforestation of the company's water sheds had been started in 1907—the present rate of plantings from the 24-acre nursery being 100,000 trees per year—making a total planting of 1,700,000 trees to date. Concerning the varieties of trees tried, they had found it advisable to confine the plantings to a combination of red-pine but were not ready to say that either was the best that could be found and expected to search further. White pine had been subject to

weevil trouble and red pine had suffered from the pine shoot moth, the control of the latter being to remove the buds in the spring and burn them—a difficult task with trees higher than 4 to 6 feet.

The trees planted had been 2 year seedlings which had been kept an additional 3 years in the transplant bed. The plantings had been on squares 6 by 6 feet, making 1,200 trees to the acre, which had to be thinned later to 600 per acre and finally to 300 per acre.

Douglas Fir seemed to be a tree free of known diseases and was to be tried but on the whole it appeared that so far white pine had been the best all around tree tried and they expected to return to it. On newly cut over ground evergreens were not satisfactory because of the rapid choking out by underbrush. White-wood or tulip seemed best for such areas.

In reply to a question, Mr. Pollitt said that the plan of planting areas with the idea of supporting the project in part by sale of Christmas trees harvested, had not appealed to him because the variety required (Norway Spruce) was too subject to disease and the price of 25 cents per tree was too low to make the scheme pay.

T. M. CURRY said that he would like to suggest hemlock as a hard species.

The Advantages of Pipe Linings

"Pipe Linings and Friction Coefficients"—E. T. KILLAM, Consulting Engineer and Associate of Alexander Potter, New York City.

In Mr. Killam's absence, his paper was read by Mr. Potter. The paper directed attention to the increased and sustained carrying capacities of ferruginous pipes protected by corrosion resistant linings of bituminous compounds or cement. He cited the work of Scobey, Fair and others in evaluating the cost of corrosion in building up friction and the recent improvement in lining materials available and methods of application. Mr. Killam pointed out the fallacy of making capacity tests on short lengths of main and felt that only long section tests under actual conditions and with provision for passing high rates of flow would reveal the true evaluation of pipe linings for increasing carrying capacity. The author presented data to augment his arguments and closed with a recommendation that coöperative studies should be undertaken through a central committee to thoroughly establish the friction coefficient for lined pipes which might be safely used in future planning. He was confident that the use of lined pipe should save many dollars of investment in that pipe of reduced diameters, which may be expected to maintain its initial carrying capacity, could safely be employed if thoroughly reliable friction coefficients were established by a central authority.

ALEXANDER POTTER, in discussing the paper, reported that the Persippany, N. J., project had involved the use of 25 miles of bitumastic centrifugally lined cast iron pipe, out of which 5 lengths, only, had to be returned to the foundry as defective. It had been learned, however, that the lining of left over pipe, laying exposed, had deteriorated badly from cracking. The lining materials had been improved since, however, by a process of polymerization designed to increase viscosity of the lining in hot weather but eliminate cracking at temperatures as low as 20 below zero.

Mr. Potter said that at the suggestion of Mr. Enslow he had made a recent investigation of the condition of a 1,400-foot section of 20 year old cast iron sewer. The question to be answered was—"Is the lining of cast iron pipe justified?" The carrying capacity of the sewer had dropped but little during the 20 years of service, the metal having been protected by "slime" coating to a point half way up the side of the pipe. Such observation indicated that force mains and pressure sewers, which flow full, probably will require no protective coating but possibly a cleaning to remove the slime deposits at intervals would be of value. At the crown of the sewer in question no tuberculation had taken place but pitting was observed to depths of as much as ¼ inch at spots.

The friction coefficient calculated with the pipe flowing at half full proved to be C = 96 to 98, notwithstanding the slime coating and the 20 year length of service. These observations (to be further confirmed and reported in more detail in a future issue of WATER WORKS AND SEWERAGE) indicated that sewer gas would attack cast iron and unless the sewer was a full flowing one the pipe should be protected at least down to the flow line, if not completely so.

C. W. SHERMAN, Consulting Engineer, Boston, Mass., directed attention to tests which had revealed coefficients

Earle Devendorf, Associate Director, New York State Health Department.

Warren J. Scott, Chief Engineer, Connecticut State Department of Health.

so low that it was difficult to account for the observed values of C = 31 for a 6 in. C. I. line; C = 42 to 44 for an 8 in. C. I. line and about the same for a 10 inch main. He felt that tests revealing coefficients of under 40, on pipe in use less than 45 years, required that we sit up and take notice before proceeding much further with unprotected pipe. Small scale tests, he felt, had been misleading in many instances and only large scale tests would reveal true conditions.

W. W. BRUSH, Chief Engineer, Department of Water Supply, New York City, reported on 60 year old 6 inch pipe in Brooklyn, N. Y., which frequently revealed, on test, a coefficient of C = 20, and for which tuberculation alone had proved responsible. He felt that if one could be assured of sustained initial carrying capacities of pipes 60 years hence, engineers would be in a position to design far more economically than heretofore.

HARRY U. FULLER, Chief Engineer of the Portland, Maine, Water District, had observed a poorer condition of 12 year old as compared to 30 years old tar dipped pipe and therefore considered it necessary to specify the material used for pipe coating on future installations and felt that the bitumastic lining demanded consideration.

THOMAS H. WIGGIN, Consulting Engineer, Federal Water Service Company, New York City, pointed out the surprising effect of very slight tubercules—(1/16 to ⅛ inch height)—on lowering of the friction coefficient to C = 80, at which point cleaning of the main was justified. Use of lined pipe had been surprisingly slow developing when one considers that bitumastic has proven

reliable after 16 to 18 years of use, and cement for even a longer period. He felt that there was already ample proof that there is no economy in poor pipe coatings. Mr. Wiggin warned that studies if made should be conducted only with instruments of guaranteed and tested accuracy to avoid misleading interpretations.

JOHN L. BIRKINBINE, Consulting Engineer, Philadelphia, Pa., reported on a test of a 10 mile line constructed of 30 inch spun lined pipe in which C figured 144 to 150. He analyzed prevailing formulae used in calculating pipe capacity and friction loss and said he felt that a new formula was needed for use in any careful evaluation studies which might be conducted.

G. E. BOYD, Engineer, Wailes, Dove-Hermiston Corp., New York City, by moving pictures showed the process of producing the new "Cem-Wrap" pipe which was developed in connection with the Hetch-Hetchy line supplying San Francisco, Calif. This process involves the use of steel pipe as the base on which is applied an inside coating of bitumastic and outside coating of cement

Leland G. Carlton, Registrar, Water Department, Springfield, Mass.

W. R. Conard, Consulting Engineer, Burlington, N. J.

mortar reinforced with wire mesh and cloth. The Hetch-Hetchy pipe, 78 inch diameter, was jointed at every third joint with Dresser Couplings to serve as expansion joints. Mr. Boyd referred to the use of bitumastic lined pipe by the Lehigh Coal Company and the economy of the reduced diameter of pipe allowed when evaluating C at 143. Replying to a question, Mr. Boyd said that "Cem-Wrap" pipe could be made in any diameter from 3 inch upward.

"A Ten Foot Parschall Measuring Flume"—CHAS. G. RICHARDSON, Chief Engineer, Builders Iron Foundry, Providence, R. I.

Mr. Richardson analyzed the advantages of the Parschall type of an open Venturi flume, as compared to an ordinary wier, for measuring and recording liquid flows. The Parschall flume, used so successfully in all sizes in connection with irrigation practice, had the advantage of requiring but 25 per cent as much head as an ordinary wier. A 10 foot flume had been constructed at the new sewage treatment plant serving Providence to measure and record flows of from 10 to 120 m.g.d. A head of but 7 inches to 2.7 feet for minimum to maximum rates would be required. By actual tests (3 hours duration) the Providence flume had been shown to be in error not more than 0.25 per cent. But a single lead off pipe connects the throat of the flume with a float well above which a Builders Iron Foundry indicating, recording and integrating instrument is set and a rate indicating instrument is also placed in the laboratory. Lantern slides pictured the Providence installation and a model to scale was exhibited. In ensuing discussion Mr. Richardson said he did not consider the Parschall flume competitive with the Venturi meter but it was none the less a highly useful flow measuring device, deserving of consideration where Venturi tubes seemed impractical.

Hydrology of Southern New England

It is impossible to do justice here to the paper presented by CALEB MILLS SAVILLE, Chief Engineer, Metropolitan Water District, Hartford, Conn. Mr. Saville's paper embraces a report on an exhaustive study of rainfall data in Southern New England and expected run off and yields of various areas. The analyses of statistics and data represent studies made by Mr. Saville in planning the new Hartford supply (50 square mile water shed area) in which records back to 1836 were employed.

Some of the interesting disclosures reveal that the earlier expected yield of 1 m.g.d. per square mile of water shed area is hazardous and instead just one half that yield could be counted upon during the recent four year period of sub-normal rainfall. The average annual precipitation for the Hartford area had been 43.66 inches for a 65 year period, but in 1930 that figure was but 34 inches. The compiled data indicated that since 1904 there had been a downward trend in rainfall which might be expected to continue downward for the 90 year period (1904-1994) and thereafter an upward trend for 90 years, as had been the condition in the period 1848-1904. Interestingly enough, the English records when plotted had been just opposite those for New England, i.e., the wettest years in America were the dryest in England and vice versa.

C. W. SHERMAN of Boston discussed the importance of maintaining rain gauging equipment in perfect condition; the effect of nearby objects such as buildings or trees; the necessity of calibration of the measure; the careful levelling; and the importance of proper elevation of the apparatus. Certain records had been worse than useless because of failure to appreciate the necessity for accuracy in rain gauge station equipment.

Iron Coagulants in Water Purification

"Advances in the Use of Iron Compounds as Coagulants"—E. L. BEAN, Chemist, Department of Public Works, Providence, R. I.

Mr. Bean briefly reviewed the history of iron compounds in water treatment practice starting with the use of ferric chloride in Belgium in 1902. The use of "copperas" (ferrous sulphate) with lime had been used on muddy and hard waters for some time but was first successfully employed on a very soft water at Providence in 1930 in order to remove manganese, ferrous iron and aluminum naturally present in the raw water of high color and void at times of oxygen.

In 1926 "chlorinated copperas" had been produced in Chicago and later adopted at Milwaukee and Houston as a means of securing an oxidized iron coagulant considerably cheaper than ferric chloride at the time. This novel coagulant had been later introduced into the water purification field—first at Elizabeth City, N. C., in 1927 and subsequently at other points. They at Providence had become attracted to its value and its use replaced ferrous sulphate with effective results. The "chlorinated copperas" had been produced continuously by admitting chlorine solution to the pipe line conveying the solution of ordinary copperas to the point of coagulant application. Sufficient excess chlorine had been added to simultaneously secure prechlorination of the raw water and oxidize the iron and manganese naturally present in

the water and thus make use of these impurities for their added coagulating value.

There had been some difficulty in storing copperas and feeding it and they had been attracted to a new ferric coagulant known as "Ferrisul"—a true anhydrous ferric-sulphate. The cost of it had been equally as attractive as had the ease of handling and for some months "Ferrisul" had been used in preference to copperas. Prechlorination had not been dispensed with because of its value in assisting coagulation and oxidation of organic matter—the latter being of greater importance than generally appreciated. With the use of ferric-sulphate it was now possible to carry any desired pH ahead of filtration and thus have a completely conditioned water passing the filters—free of alumina, iron and manganese and non-corrosive. After two years use of ferric-iron with prechlorination and lime application ahead of the filters, the sand had not become encrusted—loss on ignition being under one per cent, of which 0.75 per cent was acid soluble. Mr. Bean said that as far as he was aware the use of pH values above 9 and ferric coagulation of organically colored soft waters was novel in water purification practice.

J. J. HEALY, Chemical Engineer, Monsanto Chemical Company of Boston, Mass., in discussing Mr. Bean's paper, said that in water coagulation or other chemical precipitation processes ferric-sulphate had definite advantages over other ferric coagulants, in that it was a dry material easily handled in the usual chemical feed equipment. A solution vat or tank would be required to continuously dissolve the dry material from the feeders but a 75-gallon tank would be sufficently large to dissolve 2,000 lbs. of "Ferrisul" per 24 hours.

P. S. Wilson, Secretary, National Committee on Water Works Recovery, New York City.

L. H. ENSLOW said that he had watched the progress made by Mr. Bean in arriving at the most effective treatment for Providence conditions and considered the various steps to have been carefully planned and developed cautiously to yield results of real value. The development represented a contribution to the knowledge of water purification which upset prior conception of limitations in the practice of soft water coagulation. Mr. Bean was to be complimented on the achievement.

"Determination of Tastes and Odors in Water"—GORDON M. FAIR, Harvard University, Cambridge, Mass.

Professor Fair's paper brought together scattered and little known information concerning the effect of various compounds on the sense of smell and taste in an interesting manner. He defined the olfactic unit in evaluating odors and listed the power of certain substances to produce odors. Chlor-phenol, for instance, produced a "threshold" odor when present in water to the extent of but 0.004 m.g.m. per liter whereas phenol proper must be present to the extent of 300 times that concentration (1.2 m.g.m. per liter) to be detected. Mercaptans could be detected when only 0.006 m.g.m. per liter is present and musk and hydrogen sulphide as low as 0.0001 m.g.m. per liter.

In advocating new indices to define the "threshold values" of odors, Professor Fair suggested the term of "pO" value as a definition—the "pO" to be employed as is pH value in hydrogen-ion concentration determinations. In making dilutions to detect the threshold value of odor he had found that the logical sequence of dilutions would be one part of sample to 1, 2, 4, 6, 8, 16, 32, 64, etc., rather than employ what had proved to be impractical lesser differences in dilutions. The "pO" values being the reciprocal of the log of the dilution would then become "pO" 1, 2, 3, etc. An observer, for example, could not detect an odor change in dilutions between 1:16 and 1:32 or 1:32 and 1:64, therefore work and time would be saved in determination of threshold odor values by following the suggested scheme and reporting in terms of "pO" value.

Professor Fair exhibited improved equipment developed in the Harvard laboratories for making odor measurements. Following the idea of Baylis, an improved nose piece had been designed and a "whiffer" christened the "Osmoscope" was exhibited. An improvement in the Spaulding method of determining the "threshold value" of odor by dilution with water had been that of diluting the atmosphere above the sample with pure air. A novel device, known as the Twin Sphere Osmometer, for such dilution control, had been designed and its use was demonstrated in conjunction with the Osmoscope "whiffing" device.

PROFESSOR C. E. A. WINSLOW, of Yale University, said that he was highly impressed with this improved technique of making odor determination and complimented Professor Fair and Mr. Wells on this contribution to improved laboratory practice.

"Water Borne Disease in New York State"—EARLE DEVENDORF, Associate Director, Division of Sanitation, New York State Dept. of Health, Albany, N. Y.

Indicative of the need of continued vigilance in the matter of safeguarding health by insuring the safety of water supply, it probably surprised many to listen to Mr. Devendorf's review of 11 outbreaks of water borne disease in New York State since 1920—some quite costly. One outbreak particularly impressive was that at Akron, N. Y., where the town had been extremely hard hit with 284 cases of typhoid among its 2,000 residents. The source of the disease—a well drilled in limestone which suffered pollution through fissues connecting with a creek. Three other outbreaks had been traced to cross connections with industrial supplies.

The outbreak at Olean, N. Y., was the most recent (1928) sizeable one—238 cases—which was traced to entrance of polluted river water into a broken suction line. Failure to keep up systematic tests for residual chlorine and falsified reports filed with the State Department of Health had prevented detection of the pollution which would have been discovered had residual chlorine tests been kept up.

The most recent serious pollution threatening American municipalities along the Niagara River had occurred in March of this year when it became impossible to maintain residual chlorine in the water because of sudden rises in chlorine demand. The flushes of pollution had been traced to sudden releases of sewage laden waters locked in the Buffalo harbor by ice. The pollution passing out into Lake Ontario had traveled unbelievable distances to affect the supplies at Rochester and Oswego.

In reply to questions, Mr. Devendorf said that the Olean outbreak had cost the city $425,000 in damage suits to date. Responsibility had been fixed on the Board of Water Commissioners, who had failed to appreciate the fact that they could be held to account.

E. S. CHASE remarked that it appeared to him that

failure on the part of municipal officials to follow recommendations of health authorities should, in the case of disaster, constitute criminal negligence.

W. J. Scott, Director of Sanitary Engineering, State Dept. of Health of Connecticut, said that long time freedom from water borne disease outbreaks might readily create a feeling of a sense of security and result in laxity of supervision of the supply. He thought Mr. Devendorf's paper timely in that it pointed to the dangers of over-confidence and laxity in routine control measures.

Inspection Trip—One of Mr. Senior's "Home-Made" Dams, Constructed by the Bridgeport Hydraulic Co.

Modern Practices of Chlorination

"Modern Developments in Chlorination Practice"—Linn H. Enslow, Editor, Water Works and Sewerage and Engineer, The Chlorine Institute, New York, N. Y.

Mr. Enslow briefly outlined the history of water chlorination and discussed processes developed to overcome taste and odor troubles. Activated carbon had come to be looked upon as a material which was capable of *removing* tastes whereas ammoniation had proven a taste prevention process. Other important advantages from the use of ammonia, however, had created a second wave of enthusiasm for ammoniation and one which had the appearances of being permanent. The ability to maintain residual chlorine in mains and reservoirs for long periods rendered the ammonia-chlorine process very attractive in that taste complaints could be obviated while the sterile condition of the system provided a high factor of safety and eliminated bacterial disturbances which had produced foul water in dead ends and after-growths and corrosion, resulting in complaints. Proof that residual chlorine, carried to the far reaches of the system in the form of chloramine, had been effective in reducing putrefaction and corrosion seemed to be had in the nature of reports that less frequent flushings of dead ends is required after introducing the process. The early claims that less chlorine would be required when ammonia was used had been misleading to a large extent because in the form of chloramine higher residuals would be required than otherwise if one was to expect the same efficiencies in each instance.

Prechlorination of raw waters had increased and with justification. Several benefits had been derived from the practice—not the least being the creation of a barrier of consequence between the raw water intake and the filters, thus providing at all times a high factor of safety, not subject to sudden breakdowns which had been experienced with post-chlorination alone. Economically the advantages derived from prechlorination appeared in the form of improved condition of filter beds, more effective washing with less wash water and in many instances improved coagulation and reduced coagulant requirement. The matter of lowered bacterial efficiencies of filters supplied with prechlorinated water was a matter for academic discussion perhaps, but was no longer considered as of practical significance. Whether or not ammonia should be used in conjunction with prechlorination was a matter to be questioned in view of recent experiences. On the whole it appeared sounder practice to utilize chlorination alone for prechlorination and procure desired oxidizing effects which ammonia retarded and then apply the ammonia to the filter effluent.

In considering the slower action of chloramine where sufficiently long contact periods were not to be available to insure high sterilization efficiencies it might prove more practical to apply the chlorine first, secure the rapid effects from ordinary chlorination, and *thereafter* apply the ammonia to render the residual non tasting and more permanent. In such cases one must satisfy himself that taste production does not occur from the action of chlorine on impurities in the water, in which event this condition will not be corrected by later application of ammonia. Where the chlorine application can precede the ammonia there is something to be gained in addition to rapid disinfection, viz.: the reduced ammonia requirement. In such a case only sufficient ammonia to combine with the residual chlorine is required and not the ratio of 1 ammonia to 4 chlorine based on the total chlorine dosage as practiced when the ammonia is first applied.

Mr. Enslow pointed out the impracticability of setting up definite requirements as to contact period or residual chlorine values required when employing the ammonia chlorine process in the orthodox manner of adding the ammonia first. The pH value, and temperature of the water had an important bearing on results to be anticipated and whereas a water of pH values under seven might be effectively sterilized with 0.2 p.p.m. residual chloramine chlorine after 15 minutes, at temperatures approaching zero a higher residual would be required or a longer period of contact. Waters with pH approaching or above 8 would probably require as much as one hour of contact with the same residual chlorine content and such alkaline water at temperatures below 10 deg. C. might necessitate two hours of contact. It was fortunate that high residuals could be carried without taste complaints resulting but the residual and time

Inspection Trip to Reservoir of Bridgeport Hydraulic Co. (Kerr and Wiggins).

requirements would, of necessity, have to be determined in each case for the conditions at hand.

In filtration practice the most modern developments entailed prechlorination (at times rather heavy 12 to 20 lbs. per m.g.) powdered carbon applied at some point ahead of the filters, addition of ammonia to the effluent and, finally, post chlorination. Such a scheme appeared to constitute the surest method of producing a tasteless water and embodied high factors of safety, including sterile conditions in the distribution system with its several advantages.

E. SHERMAN CHASE commented on the refinements in modern water purification practice but objected to the statement made by Mr. Enslow that the Ortho-tolidin control test had put chlorination on a scientific basis and referred to the early use of start-iodide tests.

W. J. SCOTT stated that 77 per cent of the water supply of Connecticut was now being chlorinated and ammonia was used at Bridgeport, Stamford and South Norwalk and elsewhere. To overcome the short period of contact in some cases the application of the chlorine first would be necessary—the Connecticut requirements being a minimum contact of 30 minutes. In evaluating efficiency of chlorination when ammonia is used it had proven necessary to neutralize the residual with thiosulphate at the time of collecting the samples.

EARL DEVENDORF referred to the highly satisfactory results which had been obtained from the ammonia-chlorine process in New York State.

S. M. ELLSWORTH said that the ability to have high chlorine residuals present without taste would be a distinct advantage. In connection with small supplies, regulation of the chlorine application was not always sufficiently perfect to avoid over-treatment and chlorinous taste. If ammoniation overcame this condition it would be a welcome improvement.

Group Management vs. Municipal Management of Water Works Systems

An afternoon session was devoted to a Symposium on plant management in which the group management of Water Companies and municipal management of Water Departments were compared. REEVES J. NEWSOM, President, Community Water Service Company, discussed group utility management, and L. G. Carlton, Registrar, Springfield (Mass.) Water Department, discussed Municipal management.

"Group Management of Water Companies"—R. J. NEWSOM, President, Community Water Service Company.

Mr. Newsom stressed the fact that under group management higher grade personnel could be employed than otherwise because the cost could be pro-rated between the several plants. He said that the Community Water Service Company operated 42 plants, each with its individual local manager, and maintained 4 district laboratories under supervision of a highly trained chemist with long experience. The central organization interfered with local management as little as possible, believing that the maximum responsibility belonged with the individual local managers—including making of purchases within budgeted limitations, which were checked only at intervals by the central office. In purchasing materials, specifications were rather rigid—meters, for instance, being required to meet more exact requirements than the American Water Works Association standard and were tested to see that this was the case.

(NOTE: Discussion of Mr. Newsom's paper was withheld until the reading of the following paper in order that both might be discussed at one time.—Ed.)

"Municipal Management"—LELAND G. CARLTON, Registrar, Water Department of Springfield, Mass.

Mr. Carlton said that the principle of municipal management was—or if not, it should be—basically the same as that of private management. The water works of Springfield, with an average output of 14 m.g.d. and revenue of $980,000 annually, is supervised by a Board of Water Commissioners. The organization of the Water Works Department was split into three major divisions. The Engineering Division had charge of sources of supply, purification works and feeder mains. The Superintendent's Division had charge of the distribution and all distribution works and mains. The Finance Division had charge of pay rolls and all disbursements, meter reading, billing and collections.

The three member Board of Water Commissioners consisted of two men of attainment and high standing in the community, these being chosen by election, and the Mayor constituted the third member.

In respect to operating methods, Mr. Carlton said that the Water Department had been maintained on an entirely self supporting basis; paid $3,000.00 per year rental for space in the City Hall; paid taxes as a utility but received no rental on the 3,000 fire hydrants. The Department owned a hydro-power station at Cobble Mountain for which $270,000 per year rental was paid the city by the operating company. Customers numbered 23,000 which were billed quarterly on the stagger plan of dividing the city into sections for monthly billing of one section each month.

In the Superintendent's Division the following gangs were being maintained:

Meter setting, small leak repairs	Foreman and 3 laborers
Meter shop work	Foreman and 4 men
Hydrant repair, leak surveys and repair, pipe extensions	Foreman and 4 laborers
Valve operations, repairs	Foreman and 2 laborers
Night emergency crew	Foreman and 3 laborers
Garage, truck maintenance and repairs	Foreman and 2 helpers

One meter reader averaged 130 readings per day under the sub-division and district-system arrangement at Springfield. Unpaid accounts were notified after 20 days and then after 30 days the final notice was sent out and the water shut off shortly thereafter. After 60 days of non payment the bill becomes a lien on the property—this protection having been used recently.

The Water Department makes service installations at cost—the unspent balance of the required $50.00 deposit being refunded. A card system is being used to keep records of new services. Gate valve records are also kept by card system, the valve number being shown on the record card.

In reply to a question, Mr. Carlton explained that in making extensions of mains, those requesting the extension must guarantee the Department $20.00 annual income per foot of main involved, which figure represented roughly 10 per cent of the cost of a 6-inch main. Whenever water rents rose to meet the minimum $20.00 per foot minimum requirement the "guarantee revenue petition" is cancelled.

MR. NEWSOM explained that in making main extensions for real estate developments the money paid for it by the company was returned and the system taken over just as soon as the income equalled 16 per cent on the investment.

In reply to a question, Mr. Newsom said that his company had tried advertising to expand the use of water but without any great degree of success. In reply to another question he said that in taking over local water works systems his company was always con-

fronted with a demand for immediately improved service which required a contingency fund for providing betterments promptly after the purchase of a system.

Fire Service Charges and Hydrant Rentals

Asked about standby or "ready to serve" service charges to industrial customers, Mr. Newsom replied that standby or service charges were intelligent and logically correct, but psychologically bad if the justified amounts appeared on the bills. This being true, some of the ready to serve charges was usually hidden in the minimum charge item or else was included in the rate. The best argument to present to the manufacturer, arguing against ready to serve charges, had been a picture of what a similar "ready to serve" installation would cost the manufacturer in the form of investment, carrying charges and maintenance.

Asked about hydrant rentals, Mr. Newsom stated that various charges were in force on the Community Systems and frequently had been set previous to purchase of the system. Rents varied between $25 and $75 per hydrant. In some cities the "inch-foot" fire service charge, determined on diameter and length of main, was in use. The rate varied between 0.75 and 1.5 cents per inch-foot with hydrant rentals $5 to $18 per year—the higher charge being more nearly the correct one, the $5 charge being much too low.

Collections

Asked about methods of enforcing collection of water bills by water companies, Mr. Newsom said that this had not been simple during the depression. Many consumers were being carried on, but they had found these on the whole make a real effort to pay what they can. Cut-off practice had been moderated considerably but was enforced whenever justified from evidence of ability to pay and intent to deceive.

Mr. Carlton in reply to questions said that the lien law of 1924 had never been used by the Springfield Water Department until this past year. They had been forced to issue notificaiton of lien placement against 4 customers and all had paid promptly rather than face further action of the City Solicitor.

Meter Ownership and Repairs

Relative to water department ownership of all meters. Mr. Carlton said that the consumer paid for the new meter and service installation and, therefore, in repairing meters it was necessary to return the same meter to its original location. Charges for cleaning service lines was at flat rate of $3.00 per job unless there was digging involved. They had used the Staples service cleaner mostly. If the owner had preference for some particular brand of meter he could choose from 6 makes approved by the Water Department.

As to what the Water Department did with surplus income, Mr. Carlton answered that they were not allowed to build up any appreciable surplus. The $130,000 accumulation at the end of 1931 had since been dug into appreciably.

Experiences of Other Cities

Mr. Hugh McLean, Treasurer of the Holyoke, Mass., Water Department, reported that they at Holyoke were in good shape financially, paid taxes and rental for office space but did not receive income for water supplied other municipal properties.

Mr. Heffernan, of Milton, Mass., was proud of the fact that the Water Department was being paid for all water supplied other departments. Rental for hydrants was $35.00 per year. Main extensions had to be paid for in 5 years. Meters and service installation had been charged against the consumer, $60 to $75 being the average cost. The Department made a practice of charging 25 per cent profit on all service installations.

Mr. Newsom said that while superintendent at the Lynn, Mass., Water Department they had determined on a reasonable water usage by public buildings and the quantity used or wasted in excess of the allowance, had to be paid for.

Mr. Esty said that they at Danvers had been forced to employ threat to apply the lien law this past summer to collect $1,700 in unpaid bills.

Pipe Cutting Methods Discussed

The question of the best procedure in cutting cement lined pipe was raised by Mr. Heffernan who had been using the dog chisel (straight edge chisel) successfully and wished to know how others were cutting pipe.

Mr. Esty of Danvers had found the wheel cutter preferable—because it could be used by one man on sizes up to 12 inches.

Asked for an opinion, W. R. Conard of Burlington, N. J., said that he would not use either the wheel cutter or the chisel cut. He preferred the hand operated machine cutter which made an absolutely even and smooth cut. An 8-inch pipe cut required about 5 minutes with one man operating the cutter; a 12-inch pipe about 10 minutes. The machine was designed to use in or out of the ditch and cost approximately $75.00 for the size to cut up to 8 inch and about $125.00 for the larger size machine. He thought a diamond point a good cutting chisel to use on the bank but considered the machine cutter superior for all types of work.

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President of A. W. W. A. Appointed Deputy Administrator P. W. A.

Malcolm Pirnie, president of the American Water Works Association, Mayor of Scarsdale, N. Y., and chairman of the National Recovery Committee for Water Works Construction has now been advanced from Assistant Deputy to Deputy Administrator of the Public Works (Relief) Administration (P. W. A.) In taking over his new duties Mr. Pirnie will have charge of the construction industry of the country.

The appointment of an engineer so thoroughly acquainted with water works and sewerage practice, to this high authority, should be encouraging to water works and sewerage men generally and lend assurance that construction in these fields will receive the attention it deserves as a relief measure of first rank.

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Codes and Initials

No less than eleven national recovery agencies were graphically enumerated in a recent issue of the *United States News*. To clarify the atmosphere, now filled with codes and initials, we list the following abbreviations used to designate those agencies most commonly appearing in daily papers and magazines:

N. R. A.—National Recovery Administration.
P. W. A.—Public Works (Relief) Administration.
F. E. R. A.—Federal Emergency Relief Administration.
F. C. O. T.—Federal Coordinator of Transportation.
T. V. A.—Tennessee Valley Authority.
R. F. C.—Reconstruction Finance Corporation.
C. C. C.—Civilian Cnoservation Corps.

REDUCING THE COST OF ACTIVATED SLUDGE TREATMENT

By Combining Mechanical Agitation with Diffused Air Aeration Four American Cities Lower Power Consumption and Procure More Flexible Operation

By EDMUND B. BESSELIEVRE*

IT is a matter of common knowledge that the greatest single item of operating expense in an activated sludge plant is the cost of compressing the air used in the aeration tanks. In the majority of cases it is safe to say that this item alone amounts to from 35 to 50 per cent of the total plant operating cost, exclusive of capital and fixed charges. Compressed air is assuredly an expensive commodity at sewage treatment plants where from 0.8 to 1.5 cu. ft. of free air, at gage pressures ranging from 5 to 10 lbs., are required per gallon of sewage.

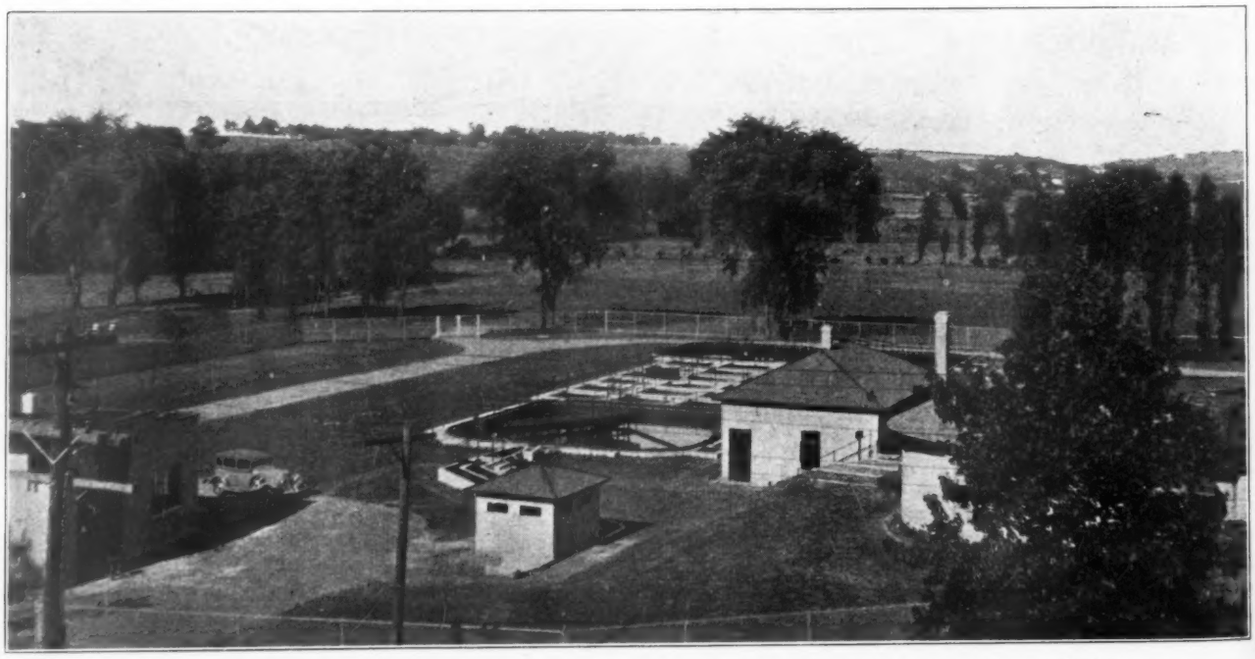
As much as a decade or two ago experimenters realized that only a very small portion of the oxygen in the air required was actually consumed in oxidizing and nitrifying the sewage. More recent studies have shown that even in the case of extremely efficient and well operated plants that employ diffused air alone, not more than 5 to 10 per cent of the air is actually made use of in the biological changes. Until comparatively recently, however, there has appeared no effective way of reducing this unreasonably large cost item. Attempts to reduce the volume of air to a point more closely approaching the minimum biological requirements, invariably led to insufficient agitation and mixing and the concomitant condition of segregation of coarse material, accumulation of sludge banks in the tanks and the inevitable—a septic sludge. Evidently, then, improvements and economies of appreciable magnitude were not to be secured without major changes in the basic concept of aeration and agitation.

*Sanitary Engineer, The Dorr Company, Inc., New York.

In their search for a more efficient method of providing aeration in the activated sludge process, it was natural that engineers should turn hopefully to mechanical aeration. As a result, a number of aerators have been developed which agitate the sewage mechanically to introduce air into the sewage at the surface wholly without the use of compressed air. A few of these mechanical aerators have reached a high stage of development and have found quite a field of utility in America and abroad. In certain instances, however, the savings in power and the anticipated reduction of the required detention period have been disappointing.

Imhoff's Development

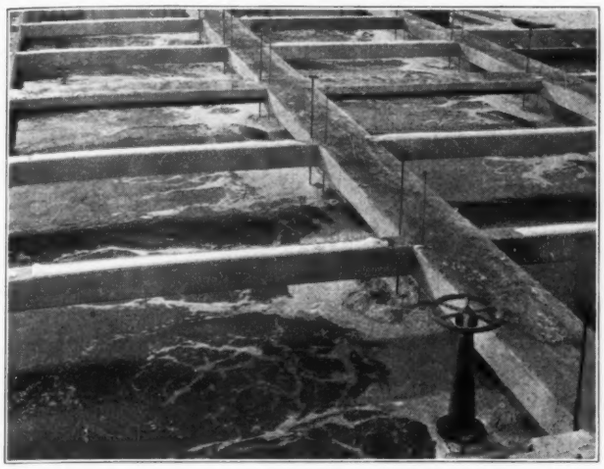
Dr. Karl Imhoff took a different viewpoint when he undertook to improve aeration practice at the model plant at Essen-Rellinghausen, Germany. He recognized the advantages of injecting the biologically needed air by diffusing it through porous plates below the surface, but he regarded the use of such expensive substance as compressed air for the simple task of agitating and mixing as wasteful practice. Working on the theory that pneumatic aeration was more efficient than mechanical aeration, but that mechanical mixing was far more efficient than pneumatic agitation, he developed and demonstrated a new aerator, combining the features of the two existing types. Retaining the sub-surface injection



The New Sewage Treatment Plant at Newark, N. Y. Surrounding the Plant on Three Sides Is a Golf Course.

of air through diffuser plates located along one side of the tank bottom, Dr. Imhoff employed a simple series of motor-driven paddles for efficiently providing the essential mixing and agitation of the sewage containing the activated sludge particles which in practice produce purification more or less in proportion to their length of travel through the sewage.

Power consumption was immediately reduced without any impairment of the quality of plant effluent, because a



Surface of Aerators, Escanaba, Mich. Note Even Distribution of Fine Air Bubbles in Sewage Traveling from Left to Right Across the Surface.

much larger proportion of the reduced amount of air used was now actually utilized for its most effective function—oxidation and nitrification. In consequence Dr. Imhoff's development has found favor abroad and more recently in this country also.

Aerators, known as the Dorrco Aerators, (covered by patents granted Dr. Imhoff with added improvements in design) have been installed at Escanaba, Mich.; Los Angeles, Calif.; Muskegon Heights, Mich.; Newark, N. Y., and Phoenix, Arizona. The installations at Escanaba, Muskegon Heights, Phoenix and Newark have now been in operation long enough to yield reliable operating data, regardless of the fact that the actual flow through these plants in all four cases is considerably less than design flow. The accompanying table of data reflects performance and shows the degree to which satisfactory operation and good results have been secured with very moderate power requirements.

The aerators used by these four municipalities employ Imhoff's distinctive principle of creating a rotary motion of the sewage (mechanically created by the paddles), which is counter current to an upward flow of diffused air bubbles injected through a single row of diffuser plates located along one side of the tank only. At Phoenix and at Newark duplex aerators consisting of two rows of paddles, one operating clockwise and the other counterclockwise, are installed. The porous plates for introducing the air are placed in a single center longitudinal line on the tank bottom and equidistant from the shafts of the two rows of paddles. By driving the paddle blades downward against the stream of rising air bubbles, the period of contact between air and sewage is prolonged. The air is thereby distributed across the complete width of the tank and the amount of air needed to secure a definite biological result is thus materially reduced. The construction is shown in an accompanying photograph. The staggering of the orientation of the paddles (being 22½ degrees apart) is for the purpose of better dynamical balance. The drive of the shaft is procured by means of chain and sprocket or by motor, directly connected to shaft, as at Muskegon Heights. Speed reduction is effected through a herringbone gear reducer, directly connected to a motor, or gear motor.

Results Secured

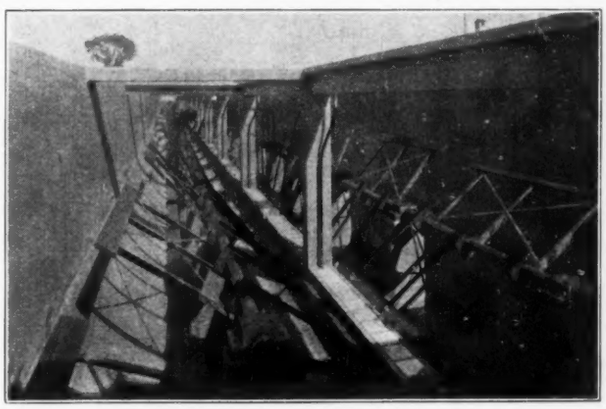
An examination of the data in the accompanying Table (I) will reveal a very creditable reduction in suspended solids, and B.O.D. Dissolved oxygen in the effluents is satisfactory and comparable with good practice elsewhere. The power consumed by the air compressors and the paddles when added give figures which are low when compared with corresponding figures for plants employing air diffusion alone. Indicated power consumption is not as low as will be the case later when the actual flows handled more closely approach the flows which these plants were designed to handle. Only fractional capacities were being used during the periods covered by operating tests, such being 69 per cent at Escanaba, 72 per cent at Phoenix, 40 per cent at Muskegon Heights, and 60 per cent at Newark. In the next to the last line of the table the power consumed corresponding to test conditions is given, while in the last line of the table these figures have been recast to give the power input which may be expected when design capacity of each plant is reached.

Results at Newark, N. Y.

Through the courtesy of Mr. Glenn D. Holmes, Consulting Engineer of Syracuse, N. Y., some further analytical and operating data on Newark, N. Y., have been made available, as shown in Table II.

At Newark gas from the sludge digesters is used as fuel in a 15 B.H.P. gas engine, direct connected to an air blower. The sludge gas averages between 650 and 700 B.T.U. per cubic foot and the gas consumption of the engine is 15-20 cubic feet per brake horse-power hour. There is available far more gas than would be necessary to drive a blower at a rate corresponding to the present flow and consequently about half the total power required for aeration—the power required for air compression—is obtained without cost other than the capital and maintenance costs of the blower installation.

In computing the power equivalent of the air used, data have been taken from runs made when the standby electric motor-blower installation was in service. This has been done in order to present total power consumption—including those both for paddle rotation and air



One of the Six Duplex Dorrco Aerator Units at the Treatment Works of Phoenix, Ariz. (Each Unit Is 300 Ft. Long, 26 Ft. 8 In. Wide and 15 Ft. Deep.)

compression—that may be used for comparison with data secured at other plants where gas engines are not used.

TABLE I—OPERATING RESULTS FROM FOUR INSTALLATIONS OF DORRCO AERATORS

	Escanaba, Mich. 3 Single Dorrco Aerators 15′x 68′ Depth—14 ft.	*Phoenix, Ariz.* 6 Double Dorrco Aerators 27′x 330′ Depth—15 ft.	*Muskegon Hts., Mich.* 4 Single Dorrco Aerators 14′x 91′ Depth—14 ft.	*Newark, N. Y.* 2 Double Dorrco Aerators 27′x 75′ Depth—14 ft.
Flow—				
Design—M.G.D.	1.00	12.0	1.67	1.50
Actual During Test—M.G.D.	0.69	9.5	0.784	0.90
Suspended Solids—				
Plant Inf.—P.P.M.	373.	106	313	296
Sec. Clar. Effl.—P.P.M.	24.	29	12	10
Reduction Suspended Solids—Per Cent	93.5	72.6	96.2	96.8
B.O.D. (5 Days)—				
Plant Infl.—P.P.M.	393	174	655*	....
Sec. Clarifier Effl.—P.P.M.	17.	17	5	....
Reduction B.O.D. (5 Days)—Per Cent	95.7	90.2	99.2	....
Dissolved Oxygen—				
Infl.—P.P.M.	0.0	0.0	0.0	....
Effl.—P.P.M.	3.8	2.4	3.4	....
Nitrates in Eff.—P.P.M.	...	1.04	...	....
Air Consumption—Cu. ft./gal. sewage	0.25	0.268	0.647	0.60
Air Pressure—Lbs. per sq. in.	5.5	5.0	5.5	5.0
Power Input to Air Compressors—H.P./M.G.D.	7.8	6.0	17.2	14.2**
Power Input to Revolving Paddles—H.P./M.G.D.	11.0	11.3	15.8	13.1
Total Power Input to Aerators—H.P./M.G.D. (Based on Flow During Test)	18.8	17.3	33.0	27.3**
Total Anticipated Power Input to Aerators H.P./M.G.D. (Based on Operation at Design Rate of Flow)	17.3 Using 0.38 cu ft. air/gal. sewage	15.0 Using 0.27 cu. ft. air/gal. sewage	15.5 Using 0.30 cu. ft. air/gal. sewage	16.85 Using 0.3 cu. ft. air/gal. sewage

NOTE.—Duration of tests: Escanaba, July 13-21, 1932; Phoenix, Sept. 1-30, 1932; Muskegon Heights, Aug. 1-31, 1932; Newark, April 1-30, 1933. All determinations based on hourly readings and hourly samples, composited daily.

*High B.O.D. at Muskegon Heights due to Tannery Wastes.

**Power input to air compressors at Newark are power readings at standby, motor-driven unit, seldom used in practice. Generally air secured from compressor, driven by gas engine using digester gas as fuel, thus reducing electric power consumption 50 per cent.

TABLE II—FURTHER ANALYTICAL AND OPERATING DATA—NEWARK, N. Y.

(First Week Each Month Since Starting Operation)

Week Ending—	Nov. 5	Dec. 3	Jan. 7	Feb. 4	Mar. 4	Apr. 1
Sewage Treated—M.G.D.	.518	.601	.709	.633	.642	.890
Total Suspended Solids—						
Raw P.P.M.	...	309	237	465	351	245
Primary P.P.M.	...	81	89	125	181	116
Final P.P.M.	...	6	29	13	18	11
Total Removal—per cent	...	98	99	97	99	96
Stability—Days	5	20	9	6	20	20
Total Solids Aeration Tanks—						
P.P.M.	...	1830	3157	2085	1605	1435
C.C. per liter	925	832	666	472	450	257
Sludge Ratio	...	2.2	4.7	4.4	3.6	5.6
Total electric current—K.W.H./day*	22.9	23.1	16.0	11.4	11.1	10.7
Total hours gas-driven Blower per day	3.2	9.0	19.1	24	24	24
Total hours motor-driven Blower per day	20.8	24	1.6	0	0	0

*Total power consumed by entire plant.

It should, however, be borne in mind that at Newark, where compressed air costs practically nothing, the gas engine is run at full capacity, supplying 0.6 cu. ft. of air per gallon at the present rate of flow. Consequently, when the plant receives its design flow, 66 per cent in excess of the present one, the total unit power consumption for aeration will be a little less than 17 H.P. per M.G.D. when using 0.3 cu. ft. of air per gallon—tests conducted elsewhere having indicated that this low air consumption gives satisfactory results.

Construction Economies and Flexibility of Operation

These four installations probably represent a smaller capital expenditure than would be required for an equivalent capacity in aerators of the ordinary diffused air type. The cost of the paddles and drive units is undoubtedly less than the cost of the additional diffuser plates, air lines, compressors and motors which would be needed otherwise. Additional economies were realized at Phoenix and at Newark by using two sets of paddles in a single wide tank, thus eliminating a dividing wall.

The flexibility of the arrangement has been distinctly helpful in realizing certain operating advantages of value. During the night, when the sewage flow is low, the air compressor plant may be shut down entirely for eight hours or so. The operation of the paddles prevents segregation of settleable solids and the already activated sewage in the tanks combined with the presence of dissolved oxygen maintained by paddle operation is sufficient to maintain proper biological conditions through the night run. This practice was used at an experimental installation at Salem, Ohio, and reduced the power required for compressing air by one third. Also if reactivation of the sludge is desired this may be carried out at the influent end of the tank by introducing the raw sewage further down the tank at some desired point. Furthermore, since the paddles effectively prevent solids segregation, the amount of air introduced at different points may be varied. For example, under certain conditions it has proved beneficial to admit a maximum amount of air at the influent end of the tank thereafter gradually reducing the input to almost nothing at the other end, thus giving a tapered agitation which enhances the formation of heavy sludge flocs which settle more quickly and thoroughly in the secondary sedimentation basins than ordinarily has been observed.

SOME ASPECTS OF CHEMICAL PRECIPITATION IN SEWAGE TREATMENT

By ALEXANDER POTTER

Consulting Engineer,
New York, N. Y.

THE treatment of sewage by an effective chemical process presents a number of basic advantages over treatment by other methods, and the possibilities of modernized chemical precipitation are such as to have a most important bearing upon the basic design and cost of sanitation programs, and upon the efficiency of sewage treatment and plant operation.

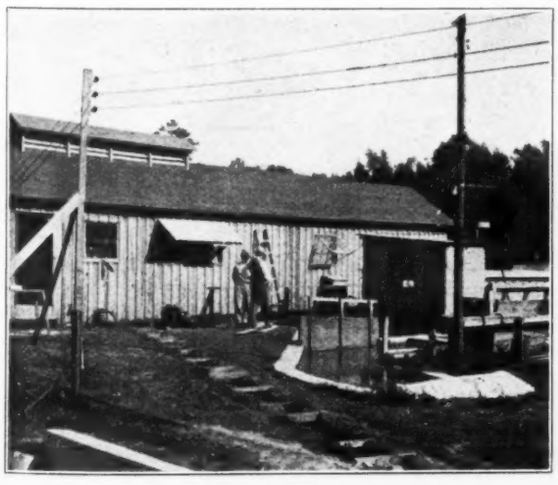
The Author

Odor Nuisance

One of the most commonly recognized and inevitable characteristics of a sewage treatment plant is odor nuisance in the vicinity of the plant site. The usual result of the construction of a sewage treatment plant in any particular locality has invariably been the substantial depreciation of property values within a large radius. The result is direct loss to property owners, and loss to the municipality through lowered tax returns.

From the financial standpoint there is another important phase of the odor problem in sewage treatment plants. With certain types of plants, for example, this problem has a most important bearing on sites selected. For instance, where this problem is a factor, and that means nearly everywhere, it is necessary for engineers to locate plants at a substantial distance from sewer districts; or to select sites where the least damage to property would occur. Sometimes, too, it is necessary for a municipality to pay excessive prices for a treatment plant site, because of resulting depreciated values and nuisance complaints. Rarely, however, is the dollar and cents cost of the "safeguard" thus provided against odor nuisance, charged to cost of construction or treatment.

This procedure sometimes necessitates large expenditures for main sewers to convey the sewage to relatively distant points and oftentimes involves the construction of plants at sites which, from an engineering standpoint, are most uneconomical. The site, for example, may be in low land, involving thereby, heavy structures to provide stability against unlift from ground water or high river or tide stages, or in other instances it becomes necessary to pump the sewage in order to reach a sufficiently isolated site.



The Atlanta Experimental Plant and Laboratory

In contrast with the expenditures thus necessary to minimize the effect of odor nuisance, chemical treatment offers an opportunity to locate plants in practically any district where a relatively small area of land is available. Furthermore, it is entirely possible to so operate this type of plant that the open tanks, the effluent and the sludge works will be entirely inoffensive, insofar as odors are concerned. The space required is so small that it is entirely feasible to construct a superstructure over the entire plant, making possible the location of the plant at far less distance from the collecting system than has heretofore been practical.

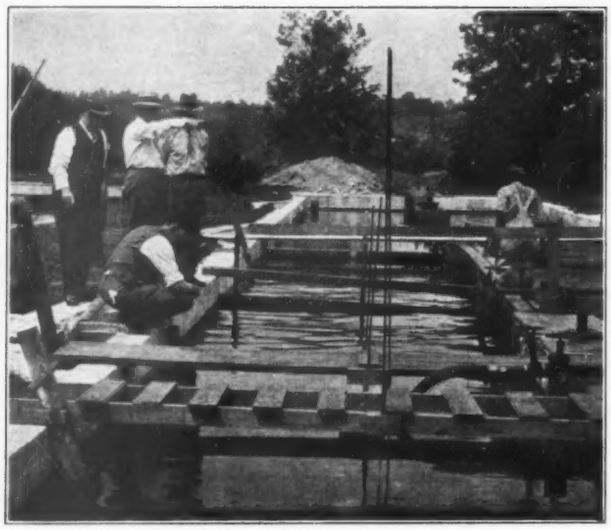
Considering these conditions, therefore, it may be stated that one of the outstanding advantages of chemical treatment of sewage is the elimination of offensive conditions and odor nuisance, and the consequent saving in cost of long main sewers to isolated sites.

The development of biological processes of sewage treatment was most active in a decade in which industrial activity was limited in scope as compared with the present time under normal trade conditions.

The basic factor controlling the efficiency of any bacteriological process of sewage treatment is the cultivation of an effective growth of bacteria to perform the work. The two major influences on bacteriological growth are temperature, and hydrogen ion concentration —that is to say, concentration of acidity or alkalinity— and if a normal range of either influence is exceeded, a marked reduction in the activity of the organisms occurs with a coincident loss in efficiency, or in certain instances, failure of the treatment process. Because of the wide variation in the pH of industrial wastes, the discharge of substantial quantities of waste, especially when these wastes are either strongly acid or alkaline, seriously impairs the efficiency of bacteriological plants, and in some instances renders plants completely inoperative.

The history of the effect of industrial wastes on treatment plant operation is voluminous and practically all municipalities enjoying a fair degree of industrial activity have experienced difficulty in that connection. In some instances, industries, after having contributed through taxes, a substantial share of the cost of treatment plants, have been forced to cease discharge of their wastes into the municipal system, or to treat their waste separately in order to bring it to a proper condition for discharge into the system. In other instances, they have been forced to discharge their wastes into a nearby water course, inevitable creating serious stream pollution.

Industry is vital to any community and troublesome wastes are the necessary by-product of the operation of many industries. Some feasible and economical method



Chemical Precipitation Studies, Atlanta, Ga. Old Imhoff Tank Converted into Settling Tank at the Peachtree Sewage Treatment Plant

must be provided for handling such wastes which will not put an unbearable burden on industry, and will prevent the pollution of streams to the degree now existing.

The most encouraging solution for this difficulty lies in the consideration of chemical treatment of sewage, and in fact with a well balanced and flexible chemical process, together with the cooperation from the industries, it is possible to effectively treat such wastes. Further than that, it is possible to utilize many of the wastes to advantage, in assisting the treatment of the sewage.

Many industries have been so harrassed by difficulties arising from waste production, that a municipality with a chemical sewage treatment plant will enjoy a favorable position to attract such industries to locate therein.

A decided advantage of the chemical treatment of sewage lies in the comparative flexibility of operation. Sewage concentration is subject to major variations, due to (1) periodic dilution with infiltration or storm water; (2) to marked hourly variations because of the daily habits of the contributing population; (3) to seasonal temperature changes, and (4) to the discharge of industrial wastes.

In addition to these variations in the nature of the raw sewage, the required purity of the effluent of the treatment plant varies to a degree which is by no means secondary to the above mentioned variations. The primary variable factors controlling effluent requirements include the stream flow available for dilution, seasonal temperature conditions and seasonal use of receiving streams or water for bathing or other purposes.

These variations are so great as to be a vital factor in the provision of proper and economical sewage treatment. The variation in concentration of sewage very often varies by the ratio of 1 to 10, and in some instances in a very much greater ratio, and the effluent requirements at a single plant may vary from practically complete treatment during critical periods of low stream flow and high temperature, to a negligible degree of treatment in periods of cold weather and high stream flow.

As a result of the lack of flexibility of many types of sewage treatment, a primary plant which may be adequate for the greater part of the year may be entirely inadequate and cause nuisance during a critical period of a few months. On the other hand, a plant may be built for complete treatment to cover conditions existing during the critical period, with a result that a much larger investment and operating cost is involved throughout the year than would be necessary if the efficiency of the plant could be varied by simplified operating changes to meet requirements.

A chemical process is quantitative, or in other words, the work performed is to a degree in proportion to the quantity of chemicals applied, and accordingly as the strength of the sewage increases or as the degree of treatment required becomes more exacting, the amount of chemicals can be changed as desired. The ability so to do will mean more efficient operation of plants than has heretofore been possible when the degree of purification obtained was in a large measure dependent upon difficultly controllable habits and activity of biological growths.

Chemical precipitation seems assured of a prominent position in the field of sanitation due to the foregoing questions of freedom from odor nuisance, ability to handle industrial waste, and inherent flexibility, together with the following considerations:

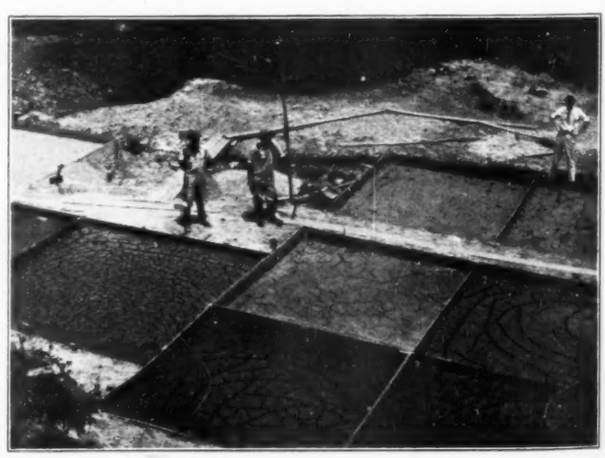
(1) Sewage treatment plants designed for chemical treatment can be constructed at a substantially lower cost than is involved in the construction of other types of works providing secondary treatment, due primarily to the short time required for chemical reaction as compared to the time required for the completion of biological action.

(2) Space required will be but a fraction of the space required for other types of works providing secondary treatment, and in many instances will be comparable with the space required for primary treatment.

(3) Where plants are overloaded, or where a higher quality of effluent is required than can be produced by existing plants, conversion can be made for the application of preliminary chemical treatment at a minor cost.

(4) Total annual costs, including fixed charges and operation costs, together with the consideration of a comparison of effluent quality, will compare very favorably with other types of secondary treatment.

The conclusions drawn in this paper are borne out by a six months' operation of a half million gallon demonstration chemical sewage disposal plant located in Atlanta, Georgia. The plant was operated under the direct supervision of E. T. Killam, my associate, assisted by H. M. Brinckerhoff of the firm of Parsons, Klapp, Brinckerhoff & Douglas, Consulting Engineers. During the operation of this demonstration plant, tests were conducted to obtain, first, high and, later, low pH effluents, with various combinations and quantities of chemicals, and with and without the use of chlorine and a complete report of the Atlanta experiments is now in the course of preparation.



Experimental Sludge Beds. Chemically Precipitated Sludge at Atlanta, Ga., in Progressive Stages of Drying. Sludge Put on at 93.5 Per Cent Water, After 5 Days Contained 74 Per Cent Water

MEETING OF THE PENNSYLVANIA SEWAGE WORKS ASSOCIATION*

THE Seventh Annual Conference of the Pennsylvania Sewage Works Association, held on September 5th-7th at State College, Pa., was opened with an address of welcome delivered by Dean Robert L. Sackett, School of Engineering, Pennsylvania State College, who reviewed the progress made in sewerage and sewage treatment during recent years.

R. O'Donnell, Retiring President.

On the evening prior to the opening of the Conference an instructive lecture and demonstrations of "Sewage Plant Tests" was given by F. E. Daniels, Chief Chemist of the State Department of Health.

The annual dinner was presided over by Harry Moses, who acted as toastmaster and directed the "Question Box" which followed.

NEW OFFICERS:

The following officers were elected for the ensuing year:

President—Harry J. Krum, City Chemist, Allentown, Pa.

Vice-Presidents—Roy L. Phillips, City Engineer, Meadeville, Pa.; E. B. Wagner, City Engineer, Downingtown, Pa.

Editor—J. R. Hoffert, State Department of Health, Harrisburg, Pa.

Secretary-Treasurer—L. D. Matter, State Department of Health, Wilkes-Barre, Pa.

The Meeting Place

That State College is an ideal meeting place for the Pennsylvania Conferences has been thoroughly demonstrated. Providing economical dormitory and restaurant accommodations or the club-like "Nittany Lion," available to those who wish de luxe hotel accommodations; a beautiful college campus and buildings—with a golf course adjacent to lure even the "dubs" to participate—and an engineering faculty headed by the esteemed Dean Sackett. Is there more to be said to justify the selection of State College as the permanent meeting place for the Water and Sewage Conferences of Pennsylvania? If so, it is a moonlit night on the campus such as witnessed during the recent conferences. There is something inspiring about State College.

"Old Main," State College, Pa. As It Looks by Moonlight. The Picture Was Taken by Giving a 30-minute Exposure in Brilliant Moonlight

"The Trouble Hour"

(President Raymond (Pat) O'Donnell presiding.)

The technical sessions were opened with the "Trouble Hour" symposium, in which plant operators presented short papers describing troubles they had experienced and means of correcting them.

"Odor Control and Grease Removal by Chlorination"—A. B. CAMERON, Erie, Pa.

Grease separation and incineration had been cause of odors at the Erie plant until chlorine was applied to the skimmings drawn from the Dorr Clarifiers to the grease collecting and separating sump. The process has been in use for practically one year with success at a cost of 11 cents per day for liquid chlorine. After experimentation it was found that a residual of 1.4 p.p.m. chlorine in the treated grease-sewage mixture would result in non odorous grease separation operations preparatory to its incineration with screenings. This had entailed the use of but 1.5 pounds of chlorine to roughly 5,000 gals. of the liquor skimmed from the clarifiers each day—the odorless grease being subsequently drawn from the concentrating tank and incinerated. Visitors could now be welcomed at the plant.

"Experiences at Meadville, Pa."—ROY L. PHILLIPS, City Engineer, Meadville, Pa.

Mr. Phillips said that they had so far had but little trouble at Meadville's new plant. Odors had been controlled by prechlorination. Smooth flow through the plant was had by arranging pumping equipment to provide 13 different rates of discharge automatically. Uniform sludge pumping was had by a four speed, motor operated, plunger-type pump. Supernatant from the digesters had been reduced to a minimum by preliminary concentration in a sludge thickening unit provided between the settling tanks and the digesters. This had perhaps proven the most useful unit in the plant and supernatant from the digesters was also given a separatory treatment in this same thickener, lime being added if necessary. Another trouble saver had been the air agitation of sewage in the influent channels to the settling tanks. This had kept the channels free from solids accumulations, had assisted in grease separation and had resulted in improved distribution of sewage and solids entering the tanks.

"Experiences at Norristown, Pa."—FRANK ALTEMUS, Supt., Sewerage, Norristown, Pa.

Poor removals of screenings on bar screens had been due to too great velocities of sewage flow. Baffling by introducing slotted stilling walls placed on the downstream side of the screen had effected an increased screenings removal from that of 10 cu. ft. per week formerly to 8.5 cu. ft. per day at present from the average sewage flow of 5 m.g.d. Heating coils in the sludge digesters had broken. The cause had been due

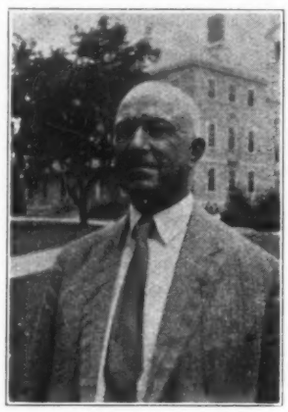
*The meeting of the Pennsylvania Water Works Operators Association will be reported in the November issue of WATER WORKS AND SEWERAGE.

to floating, with the result that the coils had to be securely anchored and not just supported on brackets as formerly. The circular grit chamber had given poor quality of grit, requiring considerable work to improve it. Even now the volatile content averaged about 20 per cent. The most recent serious trouble was occasioned by the river flooding the whole works, it having risen 11 ft. in 6 hours. All motors had to be dried out before again placing the plant in operation. It required 26 hours of pumping by a fire pumper to dewater the pump well.

"Experiences at State College, Pa."—R. R. CLELAND, San. Engr., State College, Pa.

Experiences with lime to correct poor digestion and drainability of sludge had not been encouraging. The control of pH of sludge at 6.7 to 6.8 by adding 5.5 lbs. of ground quick lime per 1,000 gals. of sludge had not improved dewatering of sludge nor its ash content. De-

Harry J. Krum, New President of the Association



Dean Robert L. Sackett

watering continued to be a problem on sand beds but there was promise from experiments under way with beds of ground anthracite coal (0.35 m.m. effective size) which had proved far superior to the sand filters so far. The anthracite did not seem to pack and very little of it came off with the sludge cake. The percentage of voids in the anthracite was greater and its volume per ton was twice that of sand.

L. E. BURNSIDE said that at Sharon, Pa., they had not gotten relief from faulty sludge digestion with lime addition. They had five digesters and added solids to each in rotation. Mixing was had by sludge recirculation pumps.

Technical Papers

"Sewage Treatment in New York State"—C. C. AGAR, Engineer, State Department of Health, Albany, N. Y.

Mr. Agar outlined the status of sewage treatment practice in New York state which has 174 plants, 67 of which provide secondary treatments and 88 of which are provided with chlorination—28 practice prechlorination continuously or intermittently. Three of the plants use sludge gas for operating engines driving air compressors.

In New York the increasing use of chlorination for one purpose or another had been one of the outstanding advances. The use of glassovers for sludge beds had been on the increase and appeared to be warranted, with a 50 per cent bed area reduction allowed.

He said that New York state was setting an example by equipping its institutions and schools with sewage treatment facilities. Fourteen such plants had been built within four years and four more are to be built. Revolving distributors for sprinkling filters were becoming more popular—some being covered with glassovers.

Lime added to fresh solids going to digesters (10 lbs. hydrated lime per day per 1,000 population) had seemed to be very helpful. To Imhoff tanks the lime was being added dry to the scum surface in the vents and worked in by hose or paddle. Operators preferred this method to preparation of a suspension in water and using that.

Mr. Agar listed numerous improvements at various plants in the state, illustrated with lantern slides. He stated, that the sewage plant operators guide put out by his department had proven sufficiently worth while to justify a revision and another printing. The chief aim of their efforts had been to help operators procure economical and effective results and a cordial relationship between the state engineer and the operator now existed.

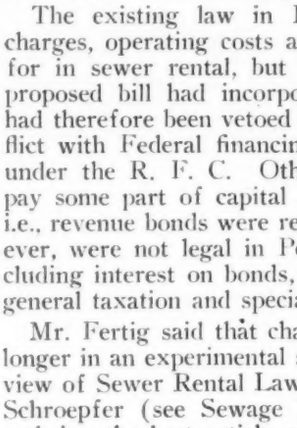
"Application of the Sewer Rental Law"—J. L. FERTIG, Director, Legislative Reference Bureau, Harrisburg, Pa.

Mr. Fertig said that 338 municipalities charge sewer rentals, 25 of these being in Pennsylvania.

The existing law in Pennsylvania allowed interest charges, operating costs and depreciation to be charged for in sewer rental, but no capital costs. A recently proposed bill had incorporated some capital costs and had therefore been vetoed by the Governor to avoid conflict with Federal financing requirements then in force under the R. F. C. Other states, he understood, did pay some part of capital charges out of sewer rentals, i.e., revenue bonds were retired thus. Such bonds, however, were not legal in Pennsylvania and first cost, including interest on bonds, would have to be covered by general taxation and special assessments.

Mr. Fertig said that charging of sewer rental was no longer in an experimental stage and referred to the "Review of Sewer Rental Laws and Charges" by Childs and Schroepfer (see Sewage Works Journal, Nov., 1932) as being the best article published on the subject.

H. M. FREEBURN, in reporting for the Committee on Sewer Rentals, said that his committee had gotten the bill covering sewer rentals through the legislature but the Governor objected to the payment of capital costs by the users of the sewer only, whereas the benefited property owners would bear no part of the charges unless



Roy L. Phillips, City Engineer, Meadville, Pa.

Frank Altemus, Superintendent Sewerage, Norristown, Pa.

they were actual users. It was therefore vetoed. Before revenue bonds could be made legal in Pennsylvania 5 years would be the minimum required time.

H. B. FOOTE of Pittsburgh, Pa., called attention to recent legislation in West Virginia making revenue bonds legal covering all costs for new work and extensions.

Such bonds could be issued by municipalities without vote of the people.

J. F. LABOON added, that the law required a Sanitary Board of 3 members to fix rates and conduct the business of the utility including collections from property owners as well as users of the sewer or water utility.

"Experiments in Sludge Heating"—E. R. QUEER, Engineering Experimental Station, State College, Pa.

In a series of carefully controlled experiments the coefficients of heat transfer from heating coils to sludge had justified the following conclusions drawn from laboratory studies in which temperatures of sludge had been maintained between 85 and 100 degrees F. Regarding likelihood of crust formation on outside of heating coils—water between 130 and 140 degrees F. could be circulated through the coils without building up an insulating crust. Coils should be 15 to 24 inches apart, within the sludge proper, and iron piping was as satisfactory as copper for heat transfer.

J. H. Hoskins, U. S. P. H. S., Cincinnati, O., Returning to His Alma Mater After Many Years

John F. Laboon, Pittsburgh, Pa.

Lancaster Plant Has Unusual Features

"Sewage Collection and Treatment at Lancaster, Pa."—JOHN F. LABOON, J. N. Chester Engrs., Pittsburgh, Pa.

Mr. Laboon briefly described the North and South Activated Sludge Plants under construction at Lancaster, Pa., and set forth reasons for selecting the activated sludge process for the North Plant. The South Plant, according to their recommendation, would have been a primary plant only, but the state required secondary treatment at this site also. Both plants had been designed identically for an average flow of 6 m.g.d. in 1945 but at present would treat 3.3 and 3.9 m.g.d. average flows having an average b.o.d. (20 day value) of 200 p.p.m. for the North Plant and 337 p.p.m. for the South Plant.

The plants will have mechanical bar screens, mechanically cleaned grit channels, and primary sedimentation and grease removal tanks (1.6 hrs. detention at design flows of 6 m.g.d.) receiving pre-aerated sewage. Aeration units will have a detention period of 6.3 hours at the 6 m.g.d. rate, plus 20 per cent returned sludge, with air input subject to variation between 0.75 and 2.0 cu. ft. per gallon from a plate area to be 9 per cent of the tank surface area. Final settling tanks will provide a detention of 1.8 hours at 6 m.g.d. flows, plus 20 per cent returned sludge—(1,200 gallons flow-through per square foot of surface area per day)—the depth being 12 ft. to flow line. These tanks are equipped with a series of air lift sampling pipes terminating at various depths to reveal the depth and quality of sludge at any time.

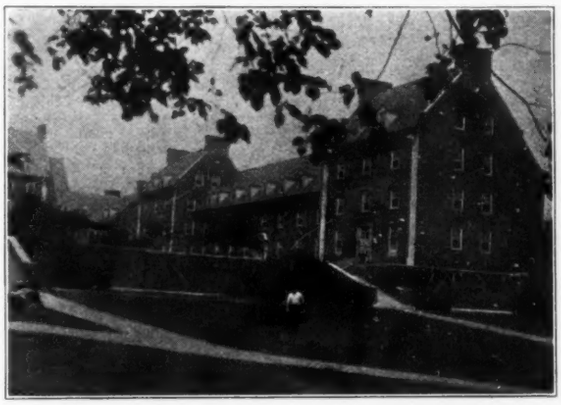
Chlorination is to be provided through 2 Wallace and Tiernan Vacuum Chlorinators operated in connection with lime feeders to produce chlorinated-lime water continuously. One ton chlorine containers were to be used.

Two sludge digesters (50 ft. diameter each) at the North Plant will provide 2.75 cu. ft. capacity per capita in 1945, or about twice that for the present. The South Plant will have but 1.46 cu. ft. digester capacity per capita in 1945. Each digester will carry, on its roof, its individual gas holder. Sludge storage tanks at the North Plant provide 2.9 cu. ft. per capita in 1945, and 1.55 cu. ft. at the South Plant. Open sludge beds will provide 1.4 sq. ft. per capita (North Plant) to 0.75 per capita (South Plant), both being for 1945 population load.

Some of the unusual features included in the plant design were the following:

Special one inch "Aloxite" diffusor plates designed to pass 30 to 36 cu. ft. of air per minute per square foot are being used. Special valves would vary the rate of air application so as to have high rates at inlet and outlet of aeration units and lower rates at the center third—thus reducing air consumption. Globe valves not being satisfactory a cone-seat valve had been specially designed for the purpose. Each digester (50 ft. diam.) would be provided with its own gas holder on the roofs at the center. Digester heating coils were to be of copper tubing.

The two air blowers (4,500 cu. ft./min. capacity) would be equipped for varying output rather than depend on a fixed output from at least five different sized blowers. One would be a Root-Connersville unit with an "unloader" and the other a centrifugal unit with jet regulation. The air cleaner would be of the continuous cleansing revolving curtain type. Chicago screw-feed sludge pumps will deliver fresh solids to the digesters and four automatic Chicago Pump Company sewage samplers would be placed on each plant. The sludge heating equipment would be of the steam type, embodying a heat exchanger, in order to avoid condensation in the heating furnace and suffer corrosion from the sulphur in the sludge gas which had been so frequently experienced with the hot water type of units.



Dormitories Pennsylvania State College (Occupied by Members of the Association During the Meeting)

The laboratory with complete equipment would cost $6,000 but was felt justified. To prevent sweating of ceilings in pipe galleries an insulating material was being used and acoustical material in the blower room was being used to minimize noise. The final tanks were being equipped with sludge blanket depth-indicator de-

vices and a sprinkler system to use effluent on the lawns and gardens was being installed.

Sterilization was to be effected by the modern lime-chlorine process involving continuous production of hypochlorite from lime and chlorine water merged together just prior to application to the sewage.

J. K. HOSKINS, Sanitary Engineer, U. S. Public Health Service, said that he was impressed with the fact that Mr. Laboon had called attention to the sufficiency of primary treatment at one of the Lancaster plants. He wondered if on the whole we were taking economic advantage of stream recovery capacity to its maximum safe limits. Engineers should protect themselves in these matters and in this, stream records would be of great value.

"The Oxygen Demand Test and Its Application to Sewage Treatment"—J. K. HOSKINS, Sanitary Engr., U. S. Public Health Service, Cincinnati, O.

Mr. Hoskins pointed out the values of the oxygen demand test but that there were acknowledged limitations to its usefulness and interpretation in practical disposal of sewage. The presence of poisonous materials, hydrogen in concentration, temperature, time, dilution water, nature of biologic life present all had a bearing on the values obtained in the test. The values obtained were dependent upon organic matter concentration but independent of the concentration of dissolved oxygen so long as some oxygen was always present. Retarding effects interfere with the 5 day test. Mr. Hoskins presented typical oxygen demand curves and formula for conversion of short period demands to total long period demands. The shape of the curves indicated that one would not be measuring the same things in oxygen demand tests applied to unoxidized effluents as to oxidized (nitrified) effluents and therefore one should appreciate this in evaluating or comparing efficiencies of treatments.

Mr. Hoskins pointed to the great rapidity of oxygen depletion (demand) exhibited in activated sludge treatment. The liquor and sludge in the aeration units exhibited a demand (consumption) of oxygen at the rate of 120 p.p.m. per hour. In the more highly nitrified stage (viz., in the final settling tanks) the demand was at a rate of 10 p.p.m. oxygen consumption per minute. It was this that accounted for the septic conditions and upset of the process which takes effect so rapidly in sludge deprived of continuous and sufficient air input. (In this connection the reader may find it interesting to examine an article by Goudey and Bennett in WATER WORKS AND SEWERAGE for May, 1933, which offers one means of suppressing oxygen consumption and consequent bulking of sludge in final settling tanks.—Ed.)

The oxygen demand test seems to be a dependable guide in determining degree of sludge digestion and is a valuable index of stream recuperation. Its mechanism has been explored, with the result that its limitations are the better understood.

Sludge Dewatering

"The Mechanical Dewatering of Sewage Sludges"—E. D. FLYNN, Oliver-United Filters, New York City.

Mr. Flynn being unable to get back from the Pacific Coast in time to present his paper, it was read by D. F. Irvin of the Oliver-United Filters.

Mr. Flynn's paper reviewed the progress made in sludge dewatering on vacuum filters, since the use of ferric iron salts made such processes economically attractive in comparison with other means of dewatering. The cost of operating and maintaining sand beds had been shown, as a result of the vacuum filtration studies at Baltimore, to be more expensive and far less dependable and less subject to control than in vacuum filtration of digested crude sludge. More recent work involving crude raw sludges and activated sludge at Chicago and Imhoff sludges at Columbus, and Cleveland, O., had yielded interesting and valuable results. Vacuum filtration of sludge, he said, was now in use at Milwaukee, at Charlotte, Winston-Salem, Gastonia and High Point, N. C.; at Houston, Tex.; Pasadena, Calif.; Dearborn, Mich.; York Township, Ont.; Hagerstown, Md.; Rockville Center, L. I.

A survey of sand bed operating costs plus interest and maintenance had revealed actual average costs at well managed sizable plants to be $4.94 per ton of dry solids handled as compared to vacuum filtration costs of $5.00 per ton. Where sludge storage tanks had been installed in connection with open beds or glass covers the costs were higher than the cost of vacuum filtration.

The interesting feature of mechanical dewatering was the economy of shorter digestion periods. Some digestion, however, would prove of value for producing gas and providing a balancing reservoir between sludge production and sludge dewatering and a reduction of solids in digestion would result also in reduction of conditioning chemical required. It appeared also that two stage digestion held considerable promise in conjunction with mechanical dewatering, in that it resulted in reduction of supernatant sludge liquor to dispose of.

L. L. HEDGEPETH, Engineer, Pennsylvania Salt Manufacturing Company, in discussion, stressed the importance of the proper conditioning of sludges and an understanding of colloidal phenomena and the action of conditioning chemicals, if the most efficient and economical dewatering was to be had. At present, nothing had equaled ferric-chloride as the conditioner—it being used in ratios of from 100 to 180 pounds of $FeCl_3$ to each ton of dry solids content of the sludge treated, the requirement varying with sludges and seasonal conditions. At Chicago and Milwaukee ferric-chloride was bringing $1.23 per cwt. of actual $FeCl_3$ delivered in solution. Since the present cost of this chemical was as low as it could be produced, the next step in reducing conditioning costs would involve technical rather than commercial developments. The work of Genter at Baltimore had considerable promise in that direction. (The figure of $1.23 per hundred pounds for ferric-chloride in 1933 compares interestingly enough with a cost of $9 to $10 per cwt. of $FeCl_3$ in 1926 when a search for a cheaper ferric salt resulted in the development of "chlorinated-copperas." This conditioner was used first at Chicago and thereafter at Houston, Texas, and Milwaukee until such time as ferric-chloride prices dropped to compete with the cost of chlorine and ferrous-sulphate required in chlorinated-copperas production.—Ed.)

"The Effect of Excessive Ground Water on Sewers and Sewage Treatment"—C. A. EMERSON, Fuller and McClintock Engrs., New York City.

Mr. Emerson's paper, read by H. M. Freeburn, called attention to the necessity of having adequate and accurate information in the designing of combined sewers and pointed out the effects of storm flows or ground water infiltration on sewage treatment works operation.

F. S. FRIEL, Cons. Engr., of Philadelphia, said that infiltration rates of 40,000 to 50,000 gals. per day per mile of sewer were common. The acceptable rate was 20,000 gals. whereas, actually, not more than 5,000 gals. per day per mile was easy of attainment in proper design and construction.

Conference Closes With a Golf Tournament

The Conference closed with a golf tournament, participated in by members of the Sewage Works Association and the Water Works Operators' Association which held its conference the two following days.

MEETING OF THE NEW ENGLAND SEWAGE WORKS ASSOCIATION

THE New England Sewage Works Association held its fifth annual meeting on October 2nd at Worcester, Mass., the attendance being approximately 100.

J. W. Bugbee, President of the Association

The morning session was devoted to technical papers and discussion. At luncheon those attending the meeting were the guests of the Norton Company, at the Worcester plant, where the "round-table" was held and the plant inspected thereafter. An interesting demonstration was made in the plant to show those present just how diffuser plates are tested and rated. The group was addressed by A. C. Higgins, President of the company, and Robert Kirkpatrick, Manager of Sales, outlined the process of manufacture of Norton products—including diffuser plates and tubes.

Demonstration of Sewer Cleaning

Later in the afternoon an inspection was made of the Worcester Sewer Department yards, shops and offices at which time a demonstration was given of local methods of sewer and catch basin cleaning which had been described by Mr. Brooks, Commissioner of Sewers, earlier in the day.

Officers elected for the ensuing year are:

President—Julius W. Bugbee, Supt. Sewage Treatment, Providence, R. I.

Vice-President—Prof. Gordon M. Fair, Harvard University, Cambridge, Mass.

Secretary-Treasurer—F. W. Gilcreas, Weston & Sampson Engrs., Boston, Mass.

Directors—R. S. Lamphear, supt. Sewage Treatment, Worcester, Mass.; G. E. Griffin, Sanitary Engineer, Greenwich, Conn.

The meeting closed with the annual dinner, at which the Hon. J. C. Mahoney, Mayor of Worcester, in his interesting address, paid high tribute to the efficiency of the local Sewer Department and in particular to J. H. Brooks, the present Commissioner of Sewerage, and H. P. Eddy and A. B. Holmstrom, who had been his predecessors. It was interesting to him, the Mayor said, to know how many men of prominence in sewerage had gotten their early experience and start at Worcester—including Eddy, Fales and the new president of the Association. Mayor Mahoney said, that the city expected very soon to receive its first allotment of $265,000 from the N.R.A. to spend on sewerage betterments during the fall and winter, with others to follow.

Papers and Discussion

"Recent Developments in Sewage Treatment"—HARRISON P. EDDY, Boston, Mass.

Mr. Eddy, having been detained on the Pacific Coast, his paper was presented by A. F. Fales, partner of Mr. Eddy.

Among recent developments, the mechanical dewatering of sludges seemed to be an advance of particular interest and vacuum filtration was to be incorporated in the proposed Toronto main plant. Ferric chloride having come down to a low price had made the mechanical process practical and economical. Incineration of sewage solids was definitely on the increase and the use of digester gas for power development as employed at Springfield, Ill., and elsewhere was worthy of greater attention. Spray drying of digested sludge had been recently selected for installation at the Plainfield, N. J. plant. In this case the sludge thrown by a centrifugal head in a closed heated chamber was taken out at the bottom as a dry powder.

Chemical precipitation had been revived and must be reconsidered in the light of present day improvements and for situations where it would serve best. He referred to the Laughlin and the Guggenheim processes as new developments.

Progress in chlorination had been marked and a large report by the American Public Health Association Committee on Sewage Treatment was to be presented shortly on this phase of treatment.

"Effect of Sewage and Effluents on Streams"—ROBERT SPURR WESTON, Boston, Mass.

Mr. Weston had been asked to present an elementary discussion of the changes taking place in sewage polluted water courses as the pollution travelled away from the point of entry. This he did in very clear language for the benefit of the novice, but his presentation was none the less appreciated by all who heard his talk. Mr. Weston then illustrated with lantern slides just what had happened in three polluted streams as revealed by survey and laboratory findings and explained the reasons for the degradation followed by recovery of the streams.

Robert Spurr Weston, Consulting Engineer, Boston, Mass.

"Safety Methods in Sewer Works"—ALFRED KINSELLA, Boston, Mass.

Mr. Kinsella made a highly instructive and practical talk on what to do (and what not to do), in the case of emergencies which were likely to occur in connection with sewer maintenance and sewage plant operation. He said that tests should always be made to determine whether or not the atmosphere would support life (16% or more oxygen content) before entering sewer pits or tanks. Equipment in the form of a detector lamp was available for such tests. Lifting more than one manhole lid in a sewer would create ventilation and that should be done before going down. Of the gas masks available he preferred the hose mask to which fresh air is pumped to the wearer from the blower-box on the outside of the sewer. Men entering dangerous places should wear a safety belt with rope attached and rope jerking signals should be planned which would indicate distress or that all was well. In addition there must be an "understand signal" to make certain that the man outside and the man inside understand each other's jerk signals. Mr. Kinsella demonstrated the use of a hose mask, the life belt and rope, the safety lamp and the prone-pressure life saving method to start an unconscious man breathing again. He warned against attempt to remove an

unconscious man from a sewer, or elsewhere, unless wearing a mask or having assistance. Failure to consider the dangers of attempted rescue without proper equipment and assistance had been responsible for multiple deaths instead of one.

Andrew Holstrom of the Norton Co. (Hosts), and R. S. Lamphear, Retiring President of the Association.

L. H. ENSLOW suggested that at each plant handling chlorine there should be on hand four ounces or more of tincture of benzoin and an electric vaporizer. Anyone suffering the after effects from chlorine exposure would find breathing of moist benzoin vapors very soothing. The patient might be given strong hot coffee or a drink of brandy if the chlorine exposure had been severe.

"Cleaning Sewers and Catch Basins"—JOHN H. BROOKS, JR., Commissioner and Superintendent of Sewers, Worcester, Mass.

Mr. Brooks described the methods and types of equipment used in Worcester for sewer cleaning. Slight and soft blockage was usually removable with the Victory propelling nozzle travelling down the sewer under water pressure. This followed by rodding and flushing. Frequently it became necessary to use Bell or Shannon scrapers which are pulled through by a tractor. To clean catch basins, specially equipped trucks, of which the city owned three, were employed. An orange-peel pucket, air operated, proved very satisfactory in connection with the truck operation. The two men on the cleaning truck and the driver of the dump truck constiuted the cleaning crew of which there were two. Catch basins were cleaned at the rate of 15 to 20 per day per machine, i.e., 30 to 40 per day for the two machines. The entire 6,000 basins were given one cleaning per year. The basins were trapped with the Coleman trap but more recently Builders Iron Foundry traps had been used.

Cleaning Diffuser Plates and Tubes

One interesting question in the "Question Box" was, "What is the best method of cleaning diffuser plates and tubes?"

Mr. Roe, Engineer, Carborundum Company, told of the method used at Decatur, Ill., wherein an oven was fired with digester gas and plates brought to a red heat. The plates had been returned to 95 to 100 per cent of their original capacity.

Mr. Fales reported that scrubbing with wire brushes had been practiced at North Toronto and the torch method of burning off the plates was used at Milwaukee.

Mr. Kirkpatrick of the Norton Company said that the Woonsocket, R. I., tubes were cleaned every six months—by burning or by hot alkali application to remove the grease. The tubes had been thus returned to 75 per cent of the original permeability.

Conditioning Sludges

Another question as to the practice in conditioning of sludges for dewatering, yielded the answer that ferric chloride was seemingly the least expensive and most efficient chemical to use. A short gentle mixing followed by immediate dewatering was important. F. W. Jones of Cleveland said that Cleveland demonstrations using various sludges indicated that the same conditioner would not prove equally effective on all sludges. In Chicago a combination of lime and ferric chloride had actually proved the best for certain conditions. The matter of conditioning was so important as to deserve study by all—hoping to uncover better and less expensive methods, if not coagulant. Attention was directed to "Ferrisul"—the ferric sulphate product just put on the market—but no experience had been had with it as a sludge conditioner.

The meeting adjourned for the inspection trip.

Members and Guests of the New England Sewage Works Association at the Plant of the Norton Co.

AN ECONOMICAL SEWAGE TREATMENT PLANT

By JOHN STROWBRIDGE

Superintendent, Water and Sewers, Dundee, N. Y.

John Strowbridge

THE Village of Dundee is situated in Yates County, New York, about midway between Penn Yan and Watkins Glen on Big Stream three miles west of Seneca Lake. Prior to 1929 the village had municipal water supply or sewerage system.

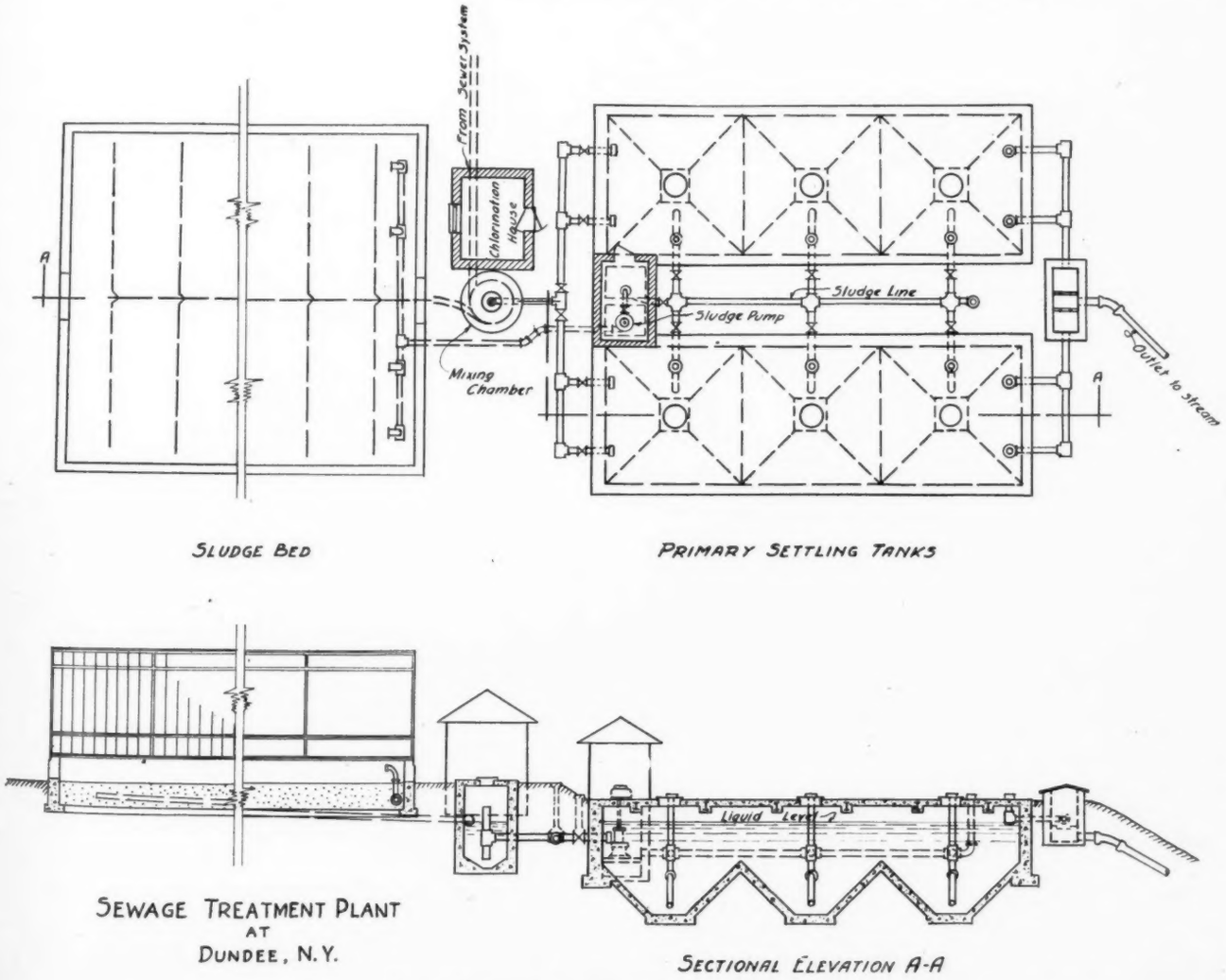
In 1928 the village officials engaged The Wm. T. Field Engineers, Inc., of Watertown, N. Y., to make a comprehensive survey to develop a source of water supply; to plan water supply and sewerage systems, including a sewage treatment plant.

The water supply system consists of an infiltration well 16 feet in diameter by 18 feet deep which yields over 100,000 gals. per day. From this well the water is pumped to a 300,000 gal. capacity elevated tank productive of a pressure of about 85 pounds per square inch throughout the village. This work, including the laying of seven miles of water mains, and sewers was done in 1929.

Sewage Treatment Plant

The sewage treatment plant is located in the southerly part of Dundee on the banks of Big Stream about a hundred yards from the nearest residence. The plant consists of a pre-chlorination contact and mixing chamber, two covered hopper-bottomed settling tanks, a sludge sump and pump, and glass covered sludge drying beds. This plant, having a designed capacity of 150,000 g.p.d., was constructed at a total cost of slightly less than $25,000.

The sewers were laid with asphalt composition joints and hence the sewage reaches the plant in a fresh, un-



Plan of Sewage Treatment Plant, Dundee, N. Y.

diluted condition. It enters, first, the chlorine contact and mixing chamber, a circular tank 6 feet in diameter and 8 feet deep. Tangential inflow at the periphery of this tank imparts a circular motion to the sewage, thus insuring thorough mixing of the chlorine and the sewage. The chlorine, regulated by a Wallace and Tiernan solution feed chlorinator, enters the contact chamber through a one inch rubber hose discharging at the bottom of the unit.

The settling tanks were designed to provide a detention of 8 hours on an average flow of 150,000 g.p.d. The writer has found one unit is sufficient to handle the present flow of 100,000 g.p.d. and hence the detention is 6 hours at present.

Somewhat Unusual Operating Procedure

The writer has operated the plant in an unusual but effective manner. The entire flow of chlorinated crude sewage is given sedimentation in one unit during a period of two to three months, the second settling tank being shut off. At the end of this two to three month period, which varies slightly as determined by the quality of the effluent, the first tank is shut off and the sewage passes through the second unit for the ensuing two to three months.

During the two months following the removal from service of the unit serving as a settling tank, the sludge which has accumulated therein digests unaided by heat or chemicals. This results in a digested sludge having the usual tarry odor, black color and rapid drainability on sand beds. After the digestion has run its course, the sludge is drawn by gravity to a sludge sump in the pump house from which it is lifted to the glass covered drying bed by a 150 g.p.m. capacity open impeller trash pump. The major portion of the supernatant liquor is left in the tanks because this material contains a very small amount of solids and pumping it to the drying bed would simply mean an excessive quantity of water being placed on the bed. The drainage from the sludge bed flows to the chlorine contact chamber.

The effluent from the settling tanks, containing not less than 0.5 p.p.m. residual chlorine, enters Big Stream about three miles above its outlet into Seneca Lake. It has in general less turbidity than the normal water in the stream.

Chlorination

Pre-chlorination is used throughout the year and during the four years the Wallace and Tiernan vacuum chlorinator has been in service no repairs have been necessary. The writer has found the use of a metal shield placed over the bell jar of the chlorinator to be effective in preventing freezing in the machine. Two 40 watt lamps placed under this shield furnish sufficient heat to prevent the formation of chlorine hydrates during the greater part of the winter. In extremely cold weather a coal stove is utilized in the chlorinator house to insure a constant flow of chlorine.

Chlorine is obtained in 150-pound cylinders. An average dose of 20 p.p.m. chlorine (16 lbs. per day) maintains a chlorine residual of 0.5 p.p.m. or more in the settling tank effluent (6 hours detention) at all times. No complaints of odors or the stream condition have been received since the plant was placed in service. We believe this to be primarily due to proper plant design and the practice of pre-chlorinating.

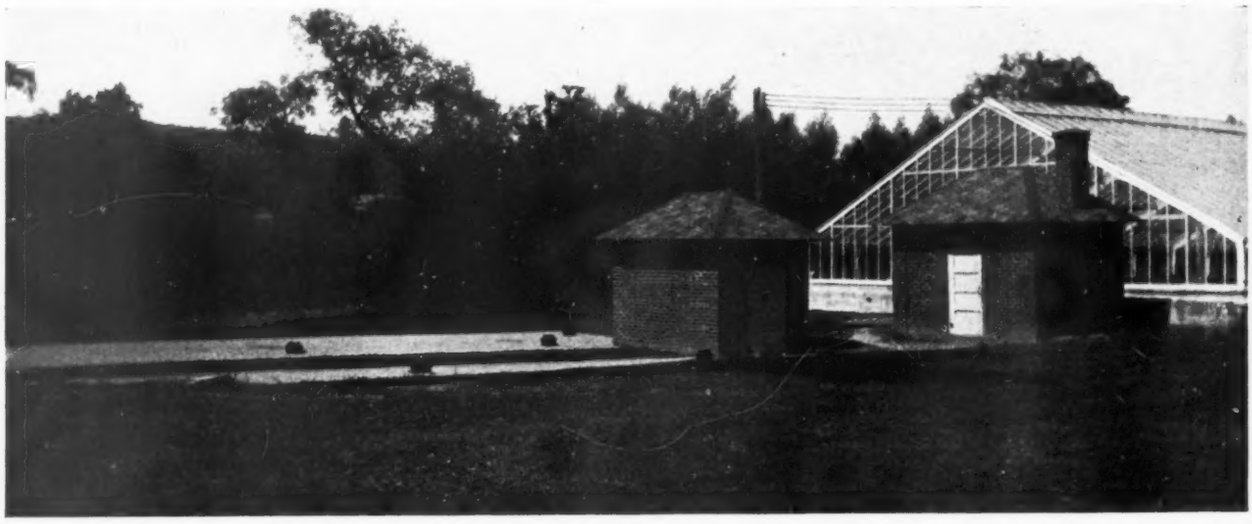
The tangential feed chlorine contact chamber has proven a very efficient mixing device. It gives a detention of twelve minutes on the average flow of 100,000 g.p.d.

The settling tanks have operated free from odor and have produced an exceptionally clear effluent for this type of tank. The tanks are covered with concrete slabs provided with manholes but even when the manhole covers are removed no odor is perceptible. The ray sewage contains an average of 5 c.c. per liter settleable solids and the effluent, after 6 hours settling period, contains 0.1 c.c. per liter (or less) settleable solids.

The digested sludge is pumped to the sludge drying beds to a depth of about 30 inches. Of course this sludge is fairly thin because of the high moisture content of the tank contents, but in two to three weeks the sludge has dried to a 3-inch cake and can be easily removed.

The writer is the only attendant and usually visits the plant in the morning to make a general inspection and the tests for solids, chlorine residual, etc., and again in the evening to check the operation of the plant. A major part of the writer's time is devoted to other work on the water and sewerage systems.

Since sludge is removed from the drying beds by local people who are in arrears in their water bill payments,



Sewage Treatment Plant, Dundee, N. Y., Left to Right: Covered Settling Tanks, Sludge Pump House, Chlorinator House, Glass Covered Sludge Beds. Cost $25,000.

the only expense to the village in operating the plant is for power used in sludge pumping and for chlorine. During 1932 the cost of operation, including chlorine, was only $1.34 per day. This cost of operation compares favorably with that of other small plants.

In addition to preventing odors and disinfecting the effluent, the writer has noted other additonal advantages from pre-chlorination. For one thing, the practical elimination of surface scum on the settling tanks materially reduces the work on these units and aids in producing the clear effluent which we obtain. It is surprising, too, to see how thoroughly the sludge from chlorinated sewage digests.

Acknowledgement.—The writer wishes to acknowledge the help of The Wm. T. Field Engineers, Inc., of Watertown, N. Y., who designed and supervised the construction of the plant, for their assistance and advice in operation.

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Association Meetings Scheduled

Oct. 7-9—**Conference of State Sanitary Engineers.** Hotel Claypool, Indianapolis, Ind. Secretary, R. E. Tarbett, U. S. Public Health Service, Washington, D. C.

Oct. 9-12—**American Public Health Association.** Indianapolis, Ind. Executive Secretary, Dr. Kendall Emerson, 450 Seventh Avenue, New York City.

Oct. 12-13—**Central States Sewage Works Association.** Hotel Claypool, Indianapolis, Ind. Secretary, Gus H. Radebaugh, % Sanitation District of Urbana, Ill.

Oct. 16-19—**Southwest Water Works Association.** Oklahoma City, Okla. Secretary, Lewis A. Quigley, Supt. Water Department, Fort Worth, Texas.

Oct. 17-18—**Ohio Conference on Water Purification.** Phoenix Hotel and Elks Club, Findlay, Ohio. Secretary, J. M. Montgomery, Supt. Water Purification, Piqua, Ohio.

Oct. 19-20—**Ohio Conference on Sewage Treatment.** Phoenix Hotel and Elks Club, Findlay, Ohio. Secretary, J. R. Collier, Supt. Sewage Treatment, Elyria, Ohio.

Oct. 19-20—**Minnesota Section American Water Works Association.** Hotel Curtis, Minneapolis, Minn. Secretary, R. M. Finch, 414 Flour Exchange Bldg., Minneapolis, Minn.

Oct. 19-21—**West Virginia Conference of Water Purification.** University of West Virginia, Morgantown, W. Va. Secretary, J. B. Harrington, Asst. Engr., State Dept. of Health, Charleston, W. Va.

Oct. 21—**Maine Water Utilities Association.** Annual meeting, Fryeburg, Me. Secretary-Treasurer, E. A. Tarr, Winthrop, Me.

Oct. 24-26—**Rocky Mountain Section American Water Works Association.** Denver, Colo. Secretary-Treasurer, Dana E. Kepner, 226 Continental Oil Bldg., Denver, Colo.

*Oct. 25-28—**California Section American Water Works Association.** Hotel Oakland, Oakland, Calif. Secretary, R. F. Brown, California Water Service Company, Stockton, Calif.

Oct. 26-28—**Missouri Valley Section.** St. Louis, Mo. Secretary, Prof. E. L. Waterman, University of Iowa, Iowa City, Iowa.

Oct. 27-28—**New York State Sewage Works Association.** Roger Smith Hotel, White Plains, New York. Secretary, A. S. Bedell, State Dept. of Health, Albany, New York.

Nov. 2-4—**Iowa Wastes Disposal Conference.** Ames, Ia. (Iowa State College). Secretary, L. J. Murphy, Iowa State College, Ames, Ia.

Nov. 13-14—**Virginia Water and Sewage Works Association.** Hotel Warwick, Newport News, Va. Secretary, H. W. Snidow, Asst. Engr. State Dept. of Health, Richmond, Va.

Nov. 13-15—North Carolina Section A. W. W. A. and N. C. Sewage Works Association.** Hotel Vance, Statesville, N. C. Secretary, Prof. H. G. Baity, University of North Carolina, Chapel Hill, N. C.

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*There has been a change made in the dates of the California Section meetings—reported earlier as 20th-24th.

**North Carolina Section dates changed—reported earlier as 6th-9th.

A Correction

In reporting a paper read by S. B. Applebaum, before the New York Section of the A. W. W. A. (page 343 WATER WORKS AND SEWERAGE for September, 1933) we are informed that two errors appear. The Zeolite filter referred to was removing 3 p.p.m. iron and not 300 p.p.m., as printed. The salt consumption in Zeolite softening is now 0.5 pound for 1,000 grains of hardness removed and so reported by Mr. Applebaum, and not 1,000 pounds as printed. We try to avoid such slips but they do creep in. We are glad to make the correction and trust that no particular harm has been done.

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Harrison P. Eddy Next President of the A. S. C. E.

Harrison Prescott Eddy, senior member of the firm of Metcalf and Eddy, Consulting Engineers, Boston, Mass., has been nominated as the next president of the American Society of Civil Engineers. Mr. Eddy, a leader in the Sanitary Engineering profession, has been a member of the Society since 1902; has received two of its awards for outstanding contributions to the literature—the Norman Medal and the Rudolf Herring Medal; was once a director and in other ways has served the Society. Mr. Eddy has been very active in committee work of the Society in matters pertaining to the Public Works Program of the R. F. C. and later the NRA and now will receive the acknowledgment due him—the honor of the presidency.

Mr. Eddy graduated from Worcester Polytechnic Institute in 1891, from which he received the honorary degree of Doctor of Engineering in 1930. He began his career as Superintendent of Sewage Treatment at Worcester, Mass., and in 1907 became a member of the firm of Metcalf and Eddy. In the field of sanitary engineering he is an international authority.

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Ohio Municipalities Speed Action on Public Works Projects

The Ohio legislature has passed a bill to aid municipalities in getting public works construction under way more rapidly. The bill was passed as emergency legislation at the request of mayors of eight of the larger cities. The new law makes it permissive to place bond issues on ballot only 30 days prior to voting instead of 60 days as in the past. Thus the municipal authorities may obtain loans or grants from the Public Works Administration at an earlier date. It seems probable that Ohio mayors realize that speed is necessary if they are to secure P. W. A. grants before the cupboard is bare of funds for that purpose. The rate at which applications are being filed makes it appear as if the warning of "first come first served" was justified.

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"Bringing Them Back Alive"

Some resident of Worcester, Mass., evidently oversupplied with cats, dropped four new born kittens down the sewer as a means of disposal. However, he did not know of the life saving device at the sewage plant. The Dorrco bar screen mechanism carefully raked the kittens out and the two that had not been drowned before reaching the plant were deposited on the screen house floor—a little bewildered and bedraggled but undamaged. They have adopted the screen house as their domicile—possibly as a show of gratitude to the Dorrco screen for saving one of their nine lives. Dorrco screens have taken out dead cows before but this is the first instance reported wherein they have removed live kittens.

EDITORIALS

Speed the Public Works Program

ON another page in this issue are printed excerpts from the address of Secretary Ickes, NRA Administrator of Public Works, which he delivered in person before the Conference of Mayors recently held in Chicago. There was perhaps too much truth in his address, for it failed to set well with several of the 180 mayors who attended from our larger cities. Regardless of where the shoe pinched, the message of the Public Works Administrator was much to the point concerning the looseness of the management of municipal affairs in far too many cases in the past. This lamentable situation is responsible for the revolt of the taxpaying public at a time when their faith in the administrators of the public's interests is so highly needed to make successful the Public Works Program of the NRA.

Secretary Ickes in his address puts it squarely to the municipal authorities as to whether the Public Works Program will serve its purpose in aiding the economic recovery of the country. Saying, that the national treasury was waiting to be drawn upon for millions of dollars for useful public works; that whereas the administration could help in many ways to push forward such projects, "it could not force cities to move any faster than they were willing to move."

While there has seemingly been distressing delays in getting the Public Works Program under way, the organization now having been perfected after careful selection of personnel of the highest caliber, the Administration is at present working double shifts in Washington with the intent of devoting the major part of its attention to municipal projects in order that these might be gotten under way without further loss of time.

Secretary Ickes and (P. W. A.) State Engineers are, moreover, stressing the fact that they do not expect a municipal project to be brought to them in perfect engineering or legal or financial form in order that it may be approved for a loan or grant. Further than this, the Administration is encouraging cities to apply for the 30 per cent grant alone, which can be put through more quickly than a loan can if the project is in shape to start work on in a reasonable time. What more could the Administration say than this:

"Bring to us the prima facie case and we will set aside money for you—then you can proceed to supply the explicit engineering, legal and financial details in a reasonable time. Bring us your projects, supported by the facts which are undoubtedly within your knowledge, and you will get prompt action."

In a message to this same Mayors' Conference the President of the United States, in his wish to inject fresh life-blood into the Public Works movement had the following to say:

"For Federal public works projects, approximately $1,600,000,000 already have been allocated. We are at the point *now* where states and municipalities should come forward quickly with proposals which will give immediate employment. . . . I assure you that after your projects have been passed upon by the State Advisory Boards they will be acted upon in Washington with a minimum of delay. We will match speed with you. The money is available and we want to put men to work."

With these calls to arms coming from the President and the Administrator of Public Works, is it not timely to give extensive publicity to these statements in order that the public may realize the fact that it is *now* the patriotic duty of each and every citizen to inquire of municipal authorities whether or not their city is participating in the move to "go over the top" in the President's drive to avoid a national calamity by making the NRA and PWA program a success.

Perhaps the chief obstacles to more rapid progress in the movement have been the unwillingness of the taxpayer to increase the municipal debt. That is patently because the average citizen has lost faith in municipal management of public funds. To overcome this attitude, is a matter of importance—one which will require education of the voting populace and stimulation of patriotism.

Another obstacle is the existing debt limitations imposed on municipalities by states. More states might follow the lead of New York and West Virginia in passing emergency legislation which will lift the municipal tax limitations or make legal the issuance of revenue bonds for the purpose of financing sanitary works and also put the question of whether or not such bonds should be issued out of control of the voters—making actions of municipal authorities subject to approval by such a state body as the Department of Health or a special Public Works Committee appointed by the Governor.

The engineering preparation and even the compliance with the requirements of difficult Circular 2, do not appear to be responsible for the major time required in getting through loans. Rather, it seems that the greatest time lost is occasioned in establishing legality of the loan and bonds—lawyer's routine if you please. Something should be done to correct this obstacle to progress as has been indicated in resolutions passed, during the recent meeting of the American Society of Municipal Engineers, calling on the PWA to arrange for the advancing of funds sufficient to get projects started immediately upon approval of the loan, and thereafter complete the time consuming legal routine and, further, that increased legal assistance for the purpose be provided.

It is highly encouraging to note the doubling up of forces in the Washington offices and the recent approval of loans and/or grants for some sixty odd water works or sewerage projects—mostly the latter—up to the time of this writing. It is also encouraging to note the increasing demand for municipal issues in the bond markets which has brought about a sudden increase in new issues recently.

The returns from that valuable survey made of the Public Works situation by a contemporary publication—*Engineering News-Record*—are also encouraging. But if the Public Works Program is to be a success it is going to be necessary to back the President in his appeal to the municipal authorities and to the "men behind the guns"—the taxpayers—to heed the call to patriotic service and put through desirable public works projects; demand the cutting of obnoxious legal routine and, if necessary, clean the local political house if it is still in disorder. Major operations may be necessary where simpler medication has failed. But, whatever it takes, must be done if we are to gain speed in making the Public Works Program a worthwhile success. Publicity and education will do most in this effort. To this end the President's appeal, if given proper publicity, will not go unheeded by the American public today.

Ammonia in Water Treatment

By L. H. ENSLOW*

THE use of ammonia and its compounds in water treatment has become an established practice. Doubt as to its merits for the following purposes no longer exists:

(1) To prevent taste production created by the reaction of chlorine and foreign substances in the water.

(2) To reduce, to some extent, the chlorine requirements of potable water and swimming pool water. Likewise, to stabilize the chlorine and thus maintain a longer sustained action on living bacteria and insure less residual chlorine dissipation caused by reactions with organic content of the water.

(3) To prevent occurrences of tastes caused by the actual free chlorine left in the treated water reaching consumers. To prevent complaints from users of swimming pools.

(4) To maintain long sustained disinfection action of the chlorine present and thus serve in preventing algae growths in open reservoirs, aftergrowths of bacteria in reservoirs and distribution systems and thereby procure control of "dead-end" troubles.

(5) In controlling "slime" growths in pipe lines and vats of paper and pulp manufacturing plants, the use of ammonia in conjunction with chlorine for this purpose has proved to be superior to chlorine alone, because of sustained action and reduced chlorine consumption.

Discussion

The failure of ammonia treatment to *remove* tastes from water, where already present prior to chlorine addition, has rendered ammonia less attractive as a taste preventative—or more properly a taste remover—than is activated carbon. For this reason the popularity of ammonia treatment as the universal remedy has subsided somewhat in favor of activated carbon—the latter having the power to remove tastes present originally, as well as those produced by chlorine.

The low point of ammonia application in water treatment practice has been reached and the use of ammonia should increase in the future for the following reasons:

Regardless of the fact that carbon may be added ahead of the filters there will without doubt be an increasing use of ammonia applied to the filtered water in conjunction with post-chlorination. It has been thoroughly established that high residual chlorine values can be carried in the water throughout distribution systems, even to the far reaches, if ammoniation is employed. The benefits from this are several, and health authorities knowing that chlorine can be carried all over the system without consumers detecting its presence by odor or taste are beginning to strongly advocate that this practice be adopted. That ammoniation is practical and has decided advantages, has been demonstrated in several cities—perhaps the most important being Cleveland, O., Richmond, Va., Albany, N. Y., Atlanta, Ga., Washington, D. C., Detroit, Mich., Indianapolis, Ind., Minneapolis, Minn., and now also to be applied at Chicago, Ill., notwithstanding physical obstacles which must be overcome in order to employ the process.

The water works authorities of Richmond (Va.) are highly pleased with the advantages gained by the use of the ammonia-chlorine treatment of the filtered water in addition to carbon treatment prior to filtration. Among other things, they have observed that less corrosion of pipe in the outlying districts results and troublesome secondary taste production in dead ends is prevented. In consequence—blowing-off of dead-ends is less frequently required. In short, putrefaction and corrosion due to biological phenomena has been checked. This same observation was made at Providence, R. I.; at Bridgeport, Conn., and elsewhere during summer when bleeding of dead-ends had been previously required at frequent intervals if not continuously, to offset corrosion and bacterial decomposition.

It has been emphasized in recent meetings of the New England Water Works Association (reported in November, 1932, and October, 1933, issues of WATER WORKS AND SEWERAGE) that it is feasible to add ammonia to the already chlorinated water for the purpose of rendering the residual chlorine persistent but non-objectionable. Thus it is permissible in many cases to add chlorine alone, secure its oxidizing value as a taste destroyer and rapid sterilizer and thereafter add ammonia to produce, from the excess chlorine, the chloramines so much to be desired. Such a reverse process of ammoniation bids fair to prove more economical than otherwise.

State Department of Health engineers, and others, have pointed out the advantages of ammoniation of small water supplies wherein the chlorine might be fed at a constant rate. Among the testimonials in behalf of ammoniation the following is an important one: "Variations in flow had been responsible for an over dosage with chlorine at times each day, with resulting complaints. The use of ammonia has made it unnecessary to watch the chlorine rate closely and renders it possible to produce a taste-free water even when carrying an abnormally high chlorine content during certain periods of the day." Ammoniation of small supplies has, therefore, distinctive advantages.

Future of Ammoniation

In the final analysis, ammonia application is found to be gaining ground rapidly for the purpose of carrying free chlorine unnoticed throughout the distribution systems and through reservoirs of large or small systems. Thus: Health will be safeguarded to the maximum, complaints reduced if not eliminated; algae and bacterial aftergrowths and putrefaction in the mains—with attendant foul tastes and corrosion (red or black water)—will be controlled. Ammonia in very small quantities is sufficient for this important feature of water purification and deserves the attention which it is receiving. Its use will continue to expand without question.

In paper and pulp manufacture and in other industrial plants, such as ice making and food production plants, the use of the ammonia-chlorine process is already, and will be further, on the increase. Chlorine alone is either not sufficiently effective for a long enough period to reach distant points, or else it creates corrosion or color fading problems of consequence in industrial plants. The reduction in chlorine consumption may be of secondary importance but is nevertheless a factor of some consequence in the control of "slimes" in manufacturing processes. The primary consideration, however, is the improved over-all efficiency of the chlorination process in increasing operating efficiencies, rather than a mere saving on chemicals.

In small water works operations, such as intermittently pumped supplies or gravity supplies fluctuating in water quality and rates of draught, there will be a more universal use of ammonia to prevent chlorinous tastes and insure safety at all times. The excess chlorine, intentionally added to normal flows or that which may be unintentionally present during hours of low water consumption (in the absence of automatic chlorination) will cease to be a cause for concern on the part of the water works superintendents. On this score and for other reasons cited, ammoniation of small supplies may be expected to grow—the ammonia being added prior to or subsequent to the chlorine, as the case demands.

*Editor, Water Works and Sewerage.

PORTLAND CEMENT PIPE COATINGS

By F. N. SPELLER

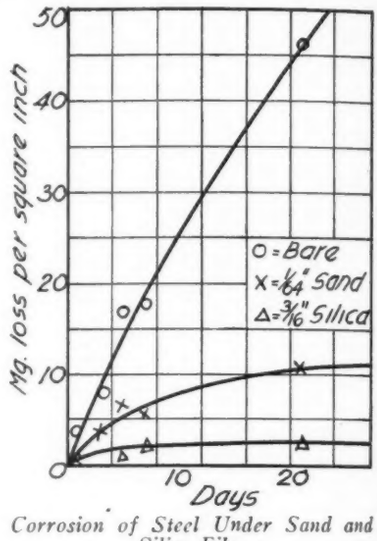
Director of Research,
National Tube Co., Pittsburgh, Pa.

THE use of hydraulic cement aggregates to prevent the deterioration by corrosion of metal pipe dates back nearly 100 years, to the time when natural hydraulic cement was first applied to the interior of water pipe. While these older pipe linings were of irregular thickness, and were often made of relatively inferior material, the results in service have been highly satisfactory. Many instances are on record of water service pipe that has been protected from corrosion and loss of carrying capacity for 50 years by a cement layer not over one-eighth inch thick. This long experience affords a sound basis for the application of portland and other hydraulic cements to the solution of many protective problems.

Hydraulic cement mixtures have been successfully used for lining parts of refinery equipment, oil gathering lines, mine waste and salt water conduits, acid sludge and waste pickle lines, hot water tanks, and for numerous other purposes. These cements, of which portland has been the one most frequently used, have given good protection in so many cases where unprotected cast iron and wrought ferrous metals have failed, that it seems highly probable that the field of use of this material has not been fully explored. In recent years, better methods of application have been devised, and a special cement having about one-third the solubility of ordinary portland cement has been developed for this purpose by National Tube Company.

Hydraulic cements protect metal pipe in two ways: by preventing the water from reaching the surface of the metal, and by maintaining a layer of alkaline water at the metal surface. Even a layer of inert silt one-sixteenth inch thick has considerable protective effect. Some of the older cement linings have become quite soft and porous in service, but still have retained most of their protective value. In many cases the cement in contact with water becomes covered with a layer of precipitated ferric hydroxide and other insoluble compounds which add considerably to the effectiveness of the coating.

At the last Soil Corrosion Conference at the Bureau of Standards, Mr. J. H. Peper, Chief Engineer, "Northern Group of Pipe Lines," described one or two practicable methods for the application of cement aggregate to the outside of pipe. The one which he has recommended for practical use employs portable sheet steel forms and is particularly applicable to reconditioning sections of pipe lines where corrosive conditions have developed or are anticipated. During the last two or three years cement has received further well deserved attention for protection of steel, and other methods of application have been developed. In the latter part of 1931, twenty-six miles of the Hetch Hetchy steel water main, traversing the San Joaquin Valley, was coated with cement concrete prior to installation by a process developed in California by Mr. W. A. Kraner. This pipe is 56 inches to 66 inches in diameter. Temporary coating plants were set up. Cement mortar (one part cement and two parts sand) was applied to a thickness of ½ inch while the pipe was rotated. Wire mesh (5 to the inch) was embedded in the mortar, and at the same time the outside was wrapped with heavy cheese-cloth to hold the cement in place during setting. Shortly after removal from the wrapping machine, the surface of the pipe was sprayed with an asphalt mulsion in order to retain the moisture during the curing stage. The coating was applied in a 12-inch wide spiral, the cement being compacted at the point of application by a vibratory device. After curing for several days, the pipe was transported by motor truck to the ditch a number of miles away without injury to the coating. We understand the contract price for this job was 9.7 cents per square foot. This process is now being developed on a commercial basis.



Corrosion of Steel Under Sand and Silica Films

An Italian inventor, Mr. A. Rocca, has developed a method for applying an asbestos-portland cement mixture to the outside of steel pipe. This process is suitable for mill operation. The coating is approximately 3/16 inch thick, and consists of about one-fourth asbestos and three-fourths portland cement. This mixture is applied by means of machinery adapted from somewhat similar equipment used in the paper-making industry. The wet cement mixture is sucked on to three or four traveling belts made of felt which pass over the pipe surface while under pressure, depositing the cement mixture in successive layers. A number of belts are used (according to the thickness of coating required) in order to obtain a sufficient number of layers of cement at the same time. This gives a tough, dense coating with considerable strength. The data given indicate a cost about the same as that for covering the Hetch Hetchy aqueduct, referred to above.

The cost of coatings of portland cement mixtures ¼ inch to ⅝ inch thick seems to be somewhat under that of fabric-rein forced bituminous coatings having an average thickness of 1/10 inch, but we must bear in mind that cost estimates for cement coating are based on comparatively limited experience.

Of course, neither portland cement nor any other material can be used under all conditions of service, but it must be recognized that in many cases this material has given satisfactory protection over long periods of time under severe conditions. In addition, portland cement coatings are free from the effect of soil stress, are available at reasonable cost, and may be applied (even in wet weather) to a surface that is not perfectly clean.

Cement linings in small steel pipe have withstood daily temperature variations of 120° F. for 6 years without damage, and in addition they have some heat-insulating value. On the other hand, they are not proof against excessive mechanical abuse or electrolysis from stray currents.

NEW EQUIPMENT AND MATERIALS.

New Recording Thermometer and Pressure Gauge

A new and improved line of 8- and 12-inch circular chart instruments has just been placed on the market by The Brown Instrument Company of Philadelphia. These instruments include thermometers in indicating and recording types for temperatures from 40° F. up to 1200° F., and indicating or recording pressure and vacuum gauges for ranges from 10 in. of water up to 5,000 lbs. All types are offered in one, two or three pen models.

New Recording Thermometer and Pressure Gauge

In developing this new thermometer line, considerable research was devoted to improving the helix mechanisms (Bourdon tubes). The mercury filled helix is built of a special stainless steel. The gas and vapor type helices are made of heat treated phosphor bronze. These thermometers may be located at distances up to 200 ft.

In the pressure and vacuum gauges, three different types of actuating movements are employed. For ranges 10 inches of water to 30 lbs., a flexible metal diaphragm is used. For ranges of 30 to 200 lbs., a spring-opposed bellows has been developed which gives a powerful pen action in this range. For pressures over 200 lbs., a helix is used.

An electric clock eliminating hand winding daily, is standard for all models at no extra cost. Hand-wound clocks are also furnished if specified. Cases are of die cast aluminum.

Other new features include: Handy toggle switch to start and stop electric clock; combination door handle and built-in lock; automatic pern release and chart clips; chart hub which does away with chart knob; convenient micrometer thumb screw permits easy recalibration of the instrument and the zero adjuster is rugged and accessible.

Catalog No. 6702, but recently issued, completely describes the nineteen features of this new line of thermometers, Pressure and Vacuum Gauges and Liquid Level Gauges and will be sent upon request. Address The Brown Instrument Company, Philadelphia, Pa.

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Dresser Develops Bell Joint Clamp

The S. R. Dresser Manufacturing Company of Bradford, Pa., have perfected a bell joint clamp (style 60) which is designed for use on bell and spigot joints that may be leaking or which may leak under existing or anticipated operating conditions. The Dresser Company announce that this joint clamp is the result of three years of research and experimentation and that it has proven effective in repeated field tests.

The bell joint clamp has been designed so as to be particularly useful in an emergency which requires rapid assembly and installation. New features incorporated in the improved joint clamp are: Uniformly distributed gasket pressure; continuous gasket recess; special oil resistant gasket of rubber; adjustable, malleable iron follower and anchor rings and heavier construction with correct metal distribution.

Dresser bell joint clamps, Style 60, are available for 3- to 60-inch cast iron pipe —for additional information illustration literature may be had by addressing S. R. Dresser Manufacturing Co., Bradford, Pa.

▼

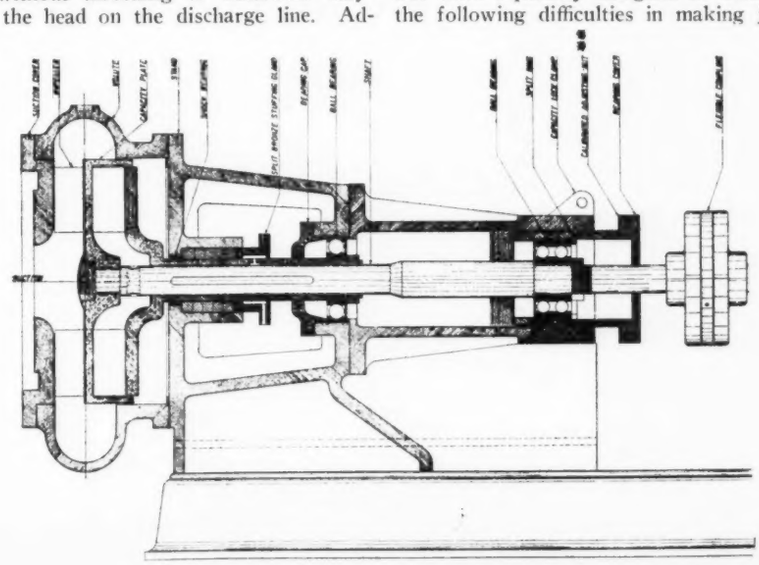
The Novel "Simplex" Adjustable Flow Sludge Pump

The Simplex Ejector and Aerator Corporation of Chicago, Ill., manufacturers of "Simplex" Aerators, announce a new patented centrifugal pump designed to provide variations in capacity, from zero to full ouput, without change of speed or without throttling or otherwise varying the head on the discharge line. Adjustment of flow can be made while the pump is in operation.

The cast-iron casing of this pump is of the volute design and the open type manganese bronze impeller has been especially designed to handle sludges efficiently.

The capacity plate—the variable flow arrangement—is of manganese bronze, slotted to pass over the impeller blade (see * in above illustration). It is movable and subject to ready adjustment at will to increase or decrease the water ways of the impeller and therefore the capacity of the unit. A micrometer adjustment nut (see ** in above illustration) on the outboard bearing can be turned to move the shaft and capacity plate to the desired position while the pump is running. The flexible coupling is designed to allow free movement of the shaft for the endwise adjustment.

These novel pumps are available in sizes to give capacities of 1 to 1,000 gals. per minute. For descriptive literature giving greater details concerning this ingenious patented pump, the reader should write the Simplex Ejector and Aerator Corporation, 2400 W. Madison St., Chicago, Ill.



Adjustable Flow "Simplex Pump"

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Tool Set for Cutting and Swedging Copper Tubing

Of interest to water works superintendents and managers is the new special tool set offered by the Geo. A. Caldwell Company of Boston, Mass. This compact tool set packed in a substantially constructed carrying box, was specially designed for use in cutting and swedging ¾ and 1 in. copper tubing, which is becoming so increasingly popular as water service pipe material.

The tools comprising the Caldwell Tool Set were especially designed to overcome the following difficulties in making joints

or installing fittings, namely: failure to cut tubing on a square right angle; failure to swedge the tube to a proper bevel; producing "bulges" in the tube, so frequently resulting from the more common methods of swedging. By use of the tools in this new set one is guaranteed, by the makers, a perfect joint. The cutter makes a perfectly square cut and use of the combinaiton tube holder, forming tool and clamp assures the proper flare and sizes the tube while being swedged, the combination which insures a perfect joint.

Caldwell's Special Tool Set

For descriptive literature and further information address Geo. A. Caldwell Company, Mattapan (Boston), Mass.

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WITH THE MANUFACTURERS

Proportioneers Move Office to Rhode Island

Proportioneers, Inc., formerly of Chicago, Ill., has moved its main office to Nine Codding St., Providence, R. I., having been incorporated as a Rhode Island corporation, with Jeff Corydon as President; R. P. Lowe, Vice-President, and H. Chafee, Treasurer. The Chicago office at 737 North Michigan Ave., Chicago, Ill., will continue to render service in the Mid-Western territory, with E. A. Goodnow as District Manager.

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Reference Catalog on Pumps and Pumping Equipment

Complete information and engineering data on pumps and pumping equipment is contained in a 400-page catalog being distributed by the Chicago Pump Company, 2300 Wolfram St., Chicago, Ill. The catalog is made up from about forty individual bulletins, each covering one particular line of pumps or equipment. These have been bound together in an attractive, strong, loose-leaf binder and is one of the most complete pump catalogs ever published.

A special bulletin in the catalog tells how to select a pump for a given service. Much valuable information on pumps, hydraulics and engineering have been brought together in tabulated form, for ready reference, in this single bulletin.

The catalog describes and illustrates the following equipment manufactured by the Chicago Pump Company: Sewage Ejectors; Screw Feed Sludge Pumps; Horizontal Centrifugal Pumps; Liquid Samplers; Comminutor or Chopper Screens; Pneumatic Water Systems; Speed Screens; Aerators; Bilge or Sump Pumps; Electric Cellar Drains; Hot or Cold Water and Brine Circulating Pumps; Vacuum Heating Pumps; Condensation Pumps; Automatic Alternators for Duplex Pumps to transfer the operation automatically from one pump to the other; Water Seal Pumps.

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New Chain Belt Pump Catalog

The Chain Belt Company, Milwaukee, has just issued a new 16-page catalog (Bulletin No. 240) describing REX Speed Prime Pumps. The theory of self-priming pumps is very well presented in the first few pages of the publication. The bulletin contains charts and other graphic representation indicating how well, and in what quantities the REX Speed Prime Pumps will handle air entering the suction, but without loss of its prime.

Some of the most useful data ever placed in the hands of pump users will be found in the new Chain Belt bulletin. A sample problem has been prepared, accompanied by the necessary simplified charts and tables, to enable contractors and other pump users to "figure" the right pump for a particular job. REX Speed Prime Pumps are equipped with the REX clean-out valve and the REX (patented) "Peeler." To the "Peeler" is given the credit for the greatly increased air handling capacity of these pumps.

The Chain Belt line of speed prime pumps are made in 2-in., 3-in., 4-in. and 6-in. sizes with capacities ranging from 10,000 to 90,000 gallons of water per hour.

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"Hypo-Chlorination of Water"

(A Water Works Hand Book)

The Mathieson Alkali Works (Inc.), has just published a 72-page hand-book of chlorination to cover the many applications of their high test hypochlorite known as "H. T. H."—a dry powder containing almost twice the chlorine content of ordinary chlorinated lime and readily soluble in water.

The booklet contains recommended procedures in applying "H. T. H." for sterilization of small water supplies, for combating algæ troubles, for cleaning and sterilizing filter beds, for sterilizing wells and new mains and for general emergency usage.

One section is devoted to a description and illustrations of the various feed devices useful in feeding solutions or the dry "H. T. H." powder. In addition, the booklet contains several tables of value prepared by its author, W. L. Savell of the Mathieson Alkali Works technical staff.

For a copy of this useful booklet (prepared for free distribution) address—Mathieson Alkali Works, Inc., 250 Park Ave., New York City.

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

Of Water Works and Sewerage, published monthly at Chicago, Illinois, for October 1, 1933.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of Water Works and Sewerage and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Gillette Publishing Co., 400 West Madison St., Chicago, Ill.

Editor, H. P. Gillette, 400 West Madison St., Chicago, Ill.

Managing Editor, C. T. Murray, 400 West Madison St., Chicago, Ill.

Business Manager, E. S. Gillette, 400 West Madison St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Gillette Publishing Company, 400 W. Madison St., Chicago, Ill.

H. P. Gillette, 400 W. Madison St., Chicago, Ill.

Mrs. R. W. Hume, 303 S. Stone Ave., La Grange, Ill.

E. S. Gillette, 400 W. Madison St., Chicago, Ill.

Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.

Provident Trust Company, 17th and Chestnut Sts., Philadelphia, Pa.

Louise Forsythe, 13 E. Windemere Terrace, Landsdowne, Pa.

La Verne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

E. S. GILLETTE,
Business Manager.

Sworn to and subscribed before me this 22nd day of September, 1933.

KITTIE C. WOULFE,
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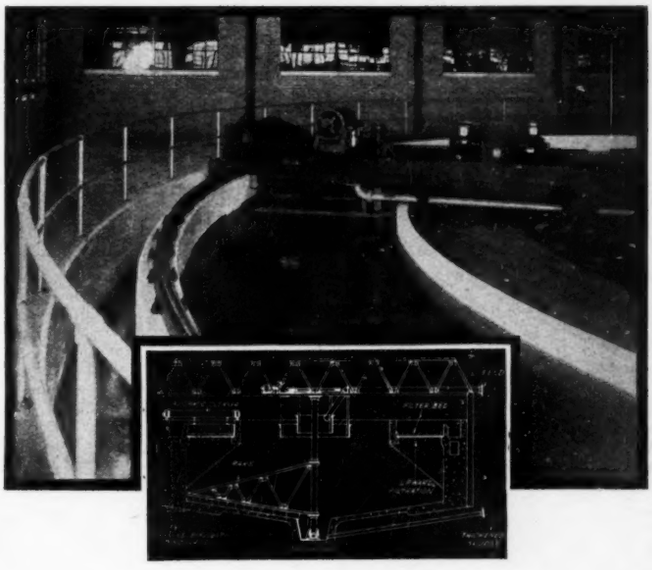

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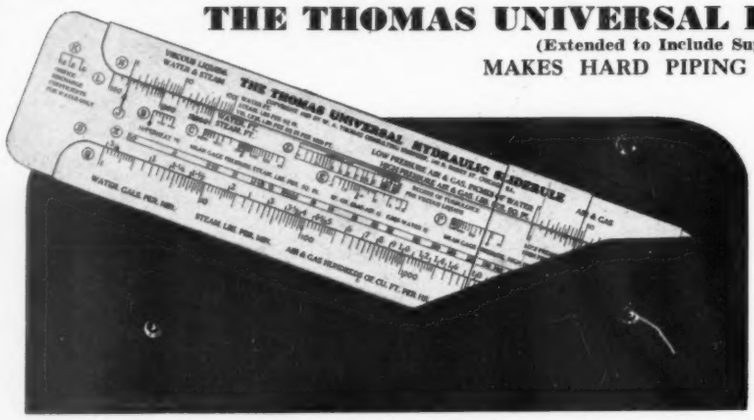

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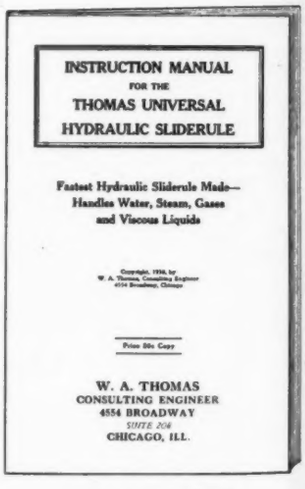

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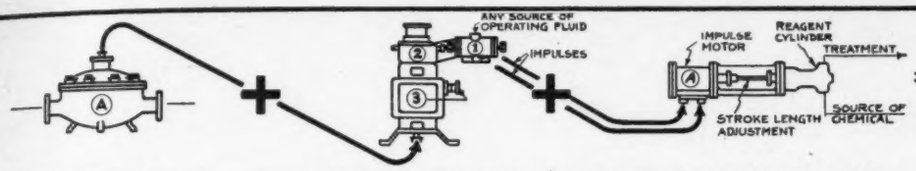

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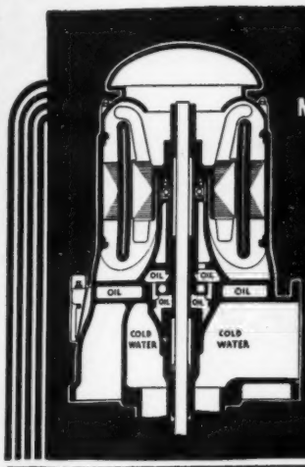

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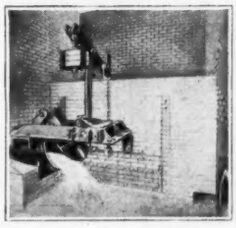

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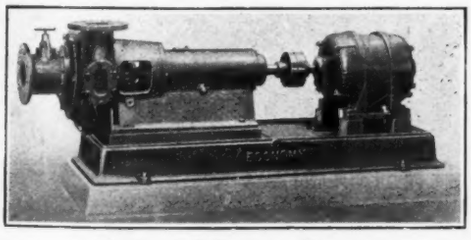

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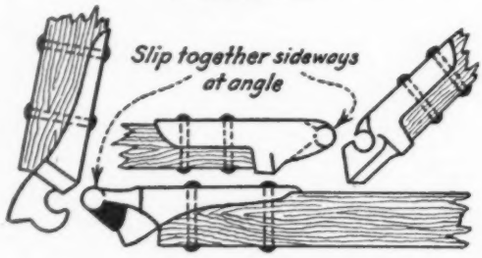

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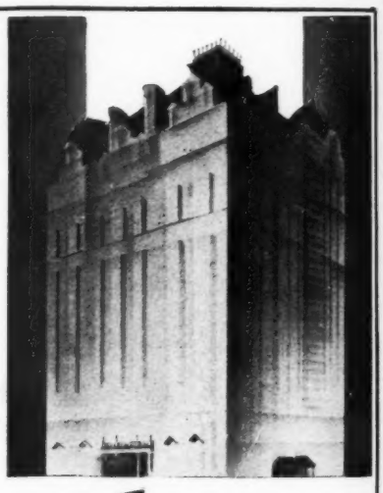

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One of the new Type K Dorr Digesters, 75 ft. dia.

● COST

Digestion of raw sludge, prior to ultimate disposal, so reduces the size of subsequent equipment that the total installed cost is 10 per cent less, and the operating cost is 20 per cent less.

● REDUCTION OF SOLIDS

Digestion reduces the dry weight of solids in raw sludge 40-50 per cent.

● SLUDGE CONDITIONING

The cost of chemicals for conditioning digested sludge for subsequent treatment is approximately 1/3 that for conditioning raw sludge.

● SLUDGE FILTRATION

Digested sludge filters about twice as rapidly as raw sludge.

● COMBUSTION

The BTU content of digested sludge is sufficient to support combustion without outside fuel.

● POWER FROM DIGESTER GAS

Digester gas, ranging from .6 to .8 cu. ft. per capita, is sufficient to provide half the power required for aeration, should activated sludge treatment later be desirable.

● SLUDGE STORAGE

Digested sludge may be stored ahead of subsequent treatment, but raw sludge cannot. A digester, designed for average flows, can absorb peak solid loads as high as 250 per cent for short periods.

● ODOR PREVENTION

Properly digested sludge is virtually odorless, whereas raw sludge emits obnoxious odors while being handled.

Let us show you how The Dorr Digestion System—regardless of preceding or succeeding treatment—will save you real money in new plants or old ones.

DORRCO

THE DORR COMPANY, INC.

ENGINEERS • 247 PARK AVENUE, NEW YORK

DENVER CHICAGO LOS ANGELES TORONTO

Affiliated with OLIVER UNITED FILTERS INC. Engineers

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FRANCE: Soc. Dorr-Oliver, Paris
ENGLAND: Dorr-Oliver Company Ltd., London
AUSTRALIA: Crossle & Duff Pty. Ltd., Melbourne
SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg
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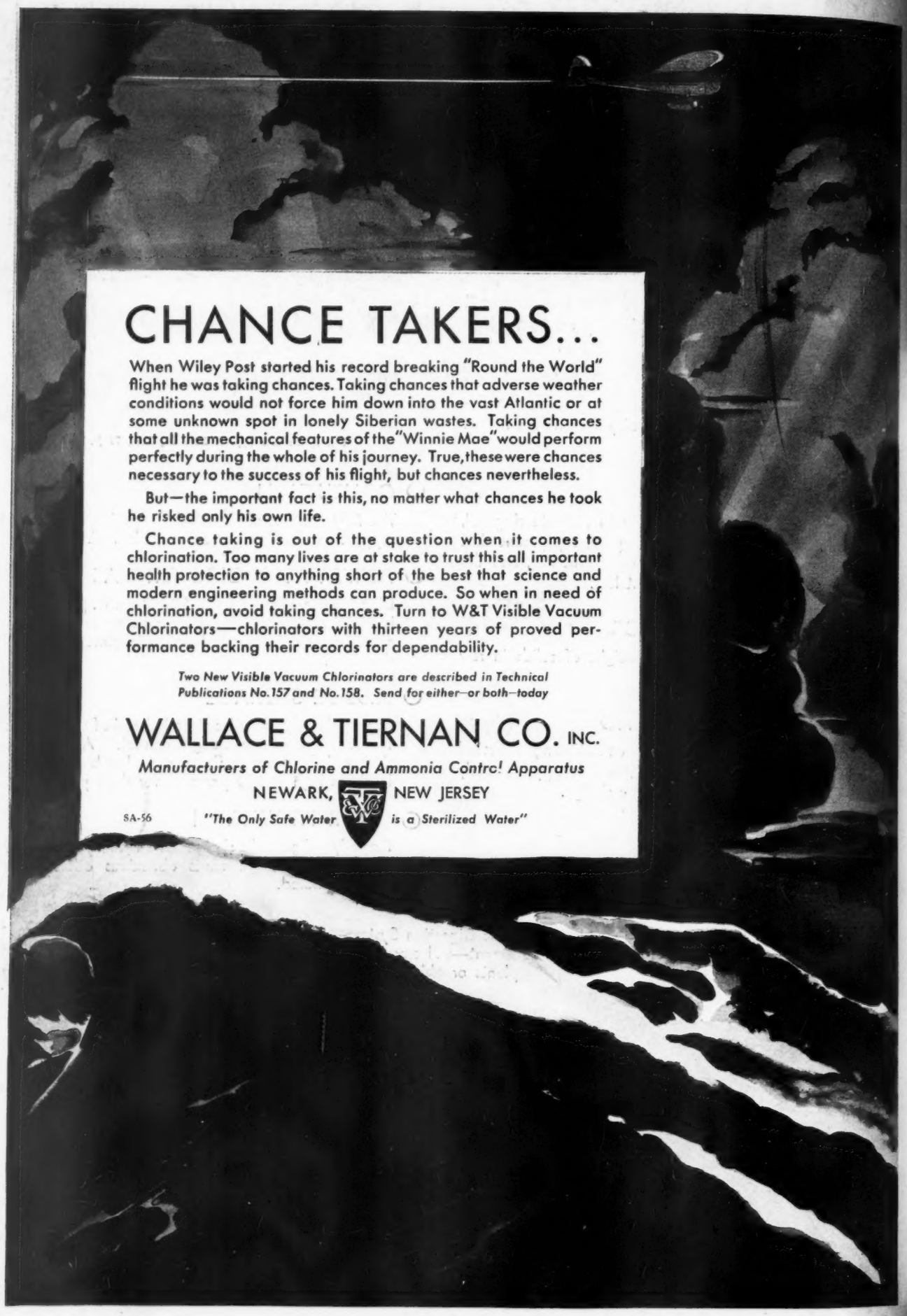

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